SCIENCE & CHRISTIANITY ed. L.R.B. MANN

SCIENCE & CHRISTIANITY

▼

FESTSCHRIFT

IN HONOUR OF HAROLD TURNER & JOHN MORTON

BEING THE PAPERS AND DISCUSSION FROM A SYMPOSIUM HELD IN AUCKLAND NEW ZEALAND APRIL 21 2001

ed. L.R.B. MANN

CCE UNIVERSITY OF AUCKLAND CENTRE FOR CONTINUING EDUCATION

Science

and

Christianity

Festschrift

in honour of

Harold Turner and John Morton

being the papers and discussion from a symposium held in Auckland New Zealand April 21 2001

L.R.B. Mann
editor

University of Auckland Centre for Continuing Education

ISBN 0-86869-009-0

Designed and Printed by Premier Print Services
Auckland, New Zealand, August 2001
2nd impression October 2002

CONTENTS

Preface

On April 21 2001 two senior Christian scholars were honoured by a symposium in Auckland on the theme 'Science and Christianity'. Some 150 participated. The papers and edited discussions from that symposium are here presented as a Festschrift dedicated respectfully to the guests of honour, Rev. Dr Harold Turner (90) and Professor John Morton (77).

The idea for this symposium arose a half-year earlier and was implemented through the University of Auckland Centre for Continuing Education by a small committee I convened. Thanks go to those colleagues - Neil Broom, Graeme Finlay, and Nicola Hoggard-Creegan - for their work, including proof-reading.

We thank Rt Rev Rob Yule, moderator of the Presbyterian church in New Zealand, for his introducing the guests of honour.

The actual talks of only a half-hour were about half the length of the papers here printed.

Two friends unable to be present on the day have contributed papers. We especially thank them for these valuable augmentations of this Festschrift.

The article about the symposium in the main Auckland newspaper that day is reproduced with permission. For this 2nd impression the opportunity has been taken to correct minor errors.

It is with deep regret that we have to record the death of Dr Turner in May 2002.

The burgeoning renewal of natural theology is evidenced by these proceedings. This Festschrift is dedicated to the needs of the offspring of atheism & agnosticism who now make up the first generation to know less than the one before; and to the two distinguished scholars whom we honoured on a memorable day; and, further afield, to all who yearn for improved relations between science and Christianity.

L. R. B. Mann
editor

photograph by permission NZ Herald

Unified Belief
There is no chasm between religion and science, say Professor John Morton (left) and Dr Harold Turner

John Morton and Harold Turner

Rt. Rev. Rob Yule

One of my brothers, now a surgeon at Dunedin Hospital, studied zoology at Auckland University under John Morton in the mid-1960s. I remember a vivid description of his teacher giving a lecture on butterflies. Reaching the climax of the lecture, Morton stretched out his arms to reveal the brilliant hues of a particular butterfly, sketched in gaudy chalk on the inside of his academic gown. The lecturer flapped his wings and, to the applause of his audience, launched himself off the podium.

These days John Morton is less likely to emulate the feats of New Zealand aviation pioneer Richard Pearse. A year ago he sustained a fall the after-effects of which prevented him from presenting in person at the symposium held at Auckland University in his honour the paper now published in this festschrift. His enthusiasm for conveying to generations of students the wonder of living organisms and their ecology is legendary. One of the old school, even in the 60s, he always lectured in an academic gown. Students remember him coming early to his classroom, to fill the roll-round blackboards with diagrams in coloured chalk of the particular creatures whose structures and functions would be extolled that day. A Baptist minister friend of mine recalls the same enthusiasm on field trips, as Morton strode hither & thither on the seashore, bending over and drawing attention to some living curiosity in the inter-tidal zone.

John Morton graduated MSc from the University of Auckland, and gained his PhD at the University of London. He became one of Britain's leading marine biologists, gaining a DSc for his work (mainly on molluscs) while still quite young. Then as the first Professor of Zoology at Auckland he was instrumental in founding that university's Marine Laboratory at Leigh, near Warkworth. While a member of the Auckland Regional Authority he promoted regional parks, making a significant contribution to preserving Auckland's glorious coastline. In numerous conservation campaigns he defended New Zealand ecosystems against loss to logging, rubbish dumps and property developments. A devoted Anglican layman, he gave long service to diocesan and national Synods, and was

instrumental in arranging the ordination of women. His 1972 book on the interface of science and Christianity, *Man, Science and God*, informed by his love of William Temple and Eric Mascall, is something of a classic in integrating belief in God with evolution.

My first encounter with Harold Turner was hearing him give a public lecture at Victoria University in 1976, when I was Ecumenical Chaplain there. I remember being so excited about this little-known expatriate New Zealand scholar who believed, as I did, that religious faith related to the whole of life. His lecture fascinated me, as a geographer by training, for he spoke of the impact of religion on geography. I remember him describing a journey on a steamer up the Adriatic coast of Yugoslavia, being able to tell at a glance which were the Muslim and which were the Christian areas. The Christians kept pigs, which foraged in the undergrowth and kept a rich tilth for the abundant vegetation, whereas the Muslims kept goats, which ate everything in sight, leaving a denuded, eroding landscape.

There was a political incorrectness about that lecture that Turner still displays. For him truth, especially truth about religious faith, is more important than whom it offends. He has hewed an independent path in scholarship that puts him in the forefront of the global study of religions as living movements, not just as textbook abstractions. He has always been a pioneer, whether it was starting New Zealand's first university bookshop and co-ed hall of residence in Dunedin, pioneering research in West Africa on African independent churches and new religious movements, or, in retirement back in New Zealand, initiating the DeepSight Trust for the study of Gospel and cultures.

Never an armchair scholar, Turner was active in field work and ventured into territory - geographical and intellectual - where fainter spirits feared to tread, as in his first-hand studies of African syncretistic religions or of Rastafarianism in New Zealand. He often found himself an advocate of the underdog and a voice for the marginalised. This is what makes his opposition to the campaign to legitimise homosexuality so significant, because it does not arise from lack of sympathy for the formerly marginal status of gays and lesbians, but rather from the observation that the claims of the homosexual lobby bear little relationship to the actual realities of human physiology and culture.

I have an interesting relationship to the theme of this symposium, because I studied in the sixties under the two main representatives of the secularising stream in New Zealand scholarship that this symposium has identified. I studied history at Auckland under Keith Sinclair, noted then for his opposition to the inclusion of theology or even religious studies in the Auckland University curriculum. In one of those divine ironies that Harold Turner will relish, with his appreciation of the laughter of God, a son of Keith Sinclair's became a convert to Christianity under my father's ministry at St Stephen's, Ponsonby, and is now training to be a Presbyterian minister. And I studied for the ministry at the Theological Hall, Knox College, Dunedin, when Lloyd Geering was Principal and first gave public glimpses of his views on the resurrection. In those years Geering was studiedly evasive about his real beliefs, but I predicted that if he carried on the path he was then beginning, he would end up where Feuerbach stood one hundred and sixty years ago, namely, that 'God' is just a human construct.

As a survivor of the secular sixties, whose views were initially formed in response to secular teachers like Sinclair and Geering, and as an outsider to the church establishment who has ended up - in the same humour of God - as Moderator of the Presbyterian Church of Aotearoa New Zealand, I feel privileged to honour two of New Zealand's greatest Christian scholars - Dr John Morton, devout Anglican, pioneering conservationist and student of living organisms, and Dr Harold Turner, the finest academic scholar of living religions the Presbyterian Church has produced.

Opening remarks

Dr Graeme Finlay

Ladies and Gentlemen: It is with a real sense of anticipation that I welcome you to today's symposium on the topic of Science and Theology. Our theme today is one of enduring fascination. One has only to think of last year's scheduled Robb Lectures: a cosmologist of great status, Professor Steven Weinberg, was to have been the speaker - on the topic 'Cosmology and God'. One cannot doubt his great erudition as a scientist, but one wonders what his theological qualifications were to speak on such a topic.

And one wonders whether the university, like many individuals, tends to regard theology as deserving of less rigour than science. We do not mean to fall into that mistake today; we are very glad to introduce people who have real expertise in a spectrum of rigorous disciplines including science, history, theology, and biomedical ethics.

And in particular a main reason we are here today is that we wish to honour two great statesmen of Christian thought - Professor John Morton and Dr Harold Turner, who have very ably spanned the spectrum of thought between Christian theology and natural science. I can myself attest to the formative influences that both of these men have had in my life, and I am very grateful to them.

The relationship between the disciplines of science and theology is a very rich one. Colin Russell, Professor of the History of Science & Technology in the Open University, has written how science developed in the West not because Western thought became submerged by Greek rationalism but because of the new environment of Biblical awareness brought about by the Reformation. Greek and other pagan ideas of science were shown to be inadequate.

Let us consider very briefly how we might define Christianity and science. Obviously these will be personal ideas, but I'm sure there will be a great degree of support from our speakers.

Christianity is that total world-view arising from God's self-revelation in the person of Jesus Christ, particularly his incarnation, his teaching, his redemptive death, his resurrection, and his glorification. Christianity entails a response to this God: of love, of faith, and of obedience.

The scientific enterprise has developed out of this response; science is part of the response to the God who has so revealed himself. Science is the systematic disciplined investigation of the natural constituents and processes of the universe. Because the God of revelation is also the God of truth, we can follow science wherever it will lead us. As an integral part of the Christian response to God, I would stress that we cannot place *a priori* restrictions on where science will lead us. Indeed our world-picture must adapt as science reveals the nature of the universe to us.

And now I would like to introduce our first speaker, Dr John Stenhouse, teacher of History at the University of Otago. He first became known to me many years ago as the author of a wonderful paper in the *NZ Journal of History* called 'The Great Gorilla Damnification of Humanity' in which he looked very revealingly at the responses of some 19th-century scientists, essentially all of whom were people of faith, to the new insights of evolutionary biology. Welcome to Auckland; we look forward keenly to what you have to say to us.

Christianity, Science and New Zealand Society: Harold Turner and John Morton in historical perspective

John Stenhouse

Presented as an abbreviated lecture at the symposium 'Science and Christianity' to honour Harold Turner and John Morton, Auckland 01-4-21.

"People are fully alive to the danger of superstition in priests - in due course of time they will find out that . . . professors may be just as bad."

- Robert, third Marquis of Salisbury, to Sir L. Mallet, 26 December 1876. [1]

Introduction

I would like to begin this paper by paying tribute to our guests of honour. In the course of long, productive, distinguished careers, Harold Turner and John Morton have sustained a tradition that has played - and will continue to play - a major role in the history of Christianity, of Western civilization, and of New Zealand culture. They are Christian scholars actively pursuing truth wherever it may be found. They have looked, it must be said, in interesting places: in the rock pools and swirling waters of coastal New Zealand; on the beaches and in the vibrant churches of Africa. They have carried forward their Christian scholarship confident in the conviction that the Father of Jesus Christ is the God of Truth, and that, in finding out about the workings of the world and its creatures, they are obeying the Great Commandment to love God with mind and heart. They thus constitute twentieth-century representatives of what I am going to call enlightened Christianity, a tradition developed in the 18th century by thinkers as diverse as Jonathan Edwards, John Wesley, & Thomas Reid, and carried on by too many modern Christians to name. Karl Barth is a particular favourite of Turner, while Morton has found inspiration in William Temple, among others.

One of my aims, and one of the major themes of our symposium, is to celebrate the lives and achievements of John Morton and Harold

Turner. I first came across Professor Morton by reading *Man, Science and God* in the mid-1980s. As an historian, I was thrilled to discover a modern Anglican Professor of Zoology and lay theologian to complement a man on whom I had worked who had played a major role in the nineteenth-century Darwinian debates here: F.W. Hutton, a 19th-century Anglican evolutionist, professor of natural science at Otago, and a lay theologian. Here, I saw, was a long-standing Christian intellectual tradition flourishing in late-20th century New Zealand. Morton, more orthodox theologically than Hutton, drew neo-Darwinism into creative & fruitful engagement with an Anglican Christianity informed by the theological insights of William Temple and Eric Mascall. I found *Man, Science, and God* spiritually, intellectually, and historically stimulating.

Harold Turner spent much of his remarkable scholarly career outside this country, teaching & building university programmes in theology & religious studies in Africa, Britain & the United States. He established an international scholarly reputation with magisterial studies of the African independent Church of the Lord (Aladura), as well as other publications too numerous to mention. Turner's first-hand experience of the incredible vibrancy & diversity of African religions, including Christianity, and his corresponding breadth of outlook, has saved him from the academic silliness of the kind I criticise later.

I come from Dunedin, and everywhere I turn I encounter Harold's influence. He founded the University Book Shop, in which I buy most of my books, and served as Parish Minister in a church located thirty yards from where I live, where my family & I worship. It sometimes feels to me almost as though Harold Turner is omnipresent.

Today I want to honour our guests by raising some hard questions, the kind that are generally avoided on occasions such as this. Let me play Devil's advocate by posing a couple. In devoting significant portions of their scholarly lives to sustaining a critical engagement between mainstream science & scholarship, on the one hand, and Christian tradition on the other, have Harold Turner and John Morton been wasting their time? If God is dead, why pay Christianity any attention at all? We honour our guests, and the noble tradition they have upheld, by asking hard questions.

Several influential New Zealand scholars have insisted that Christian tradition has indeed had its day. I want to discuss the work of two such scholars: the late Professor Sir Keith Sinclair, New Zealand's most influential 20th-c. historian, and the Rev. Dr Lloyd Geering, our most controversial theologian & religious studies scholar. These two should be seen as New Zealand advocates of the cultural revolution that

transformed much of the West during the 1960s & '70s. Sinclair, I argue, played an analogous role here to that played by such historians as the English Marxist E.P. Thompson, who despised Methodism so much that in *The Making of the English Working Class* , a hugely influential work of social history, he called it 'psychic masturbation'. Geering might be considered a New Zealand advocate of religious ideas popularized during the 1960s by Bishop John Robinson in England, in America by William Hamilton, Thomas Altizer and the 'death of God' school, and carried on more recently by Bishop John Spong and Don Cupitt's Sea of Faith movement.

In the first section of this paper I identify common themes in the historical writings of Geering & Sinclair, arguing that, despite their differences, both should be seen as modern advocates of the sceptical Enlightenment. This tradition, launched by 18th-c. writers such as Voltaire, David Hume & Edward Gibbon, deployed history to undermine the authority of Christianity by magnifying Christians' sins & stupidities. Gathering momentum during the 19th & 20th centuries, this tradition has become almost a new orthodoxy, though seldom recognized as such, amongst university-educated cultural & political élites in the post-1960s West.

In section two, I expose the historical writings of Geering and Sinclair, our local sceptics, to sceptical scrutiny. I argue that, in their eagerness to liberate New Zealanders from traditional Christianity by highlighting its moral, intellectual & historical failings, real & imagined, neither has done justice to its virtues & achievements. In particular, both have neglected or ignored the tradition of enlightened Christianity, represented by Harold Turner & John Morton among others, which, bringing reason and revelation, science and faith, Christianity and critical scholarship into fruitful creative engagement, has played, and continues to play, a more significant role in New Zealand culture, and that of the West, than either Geering or Sinclair have acknowledged.

I conclude by suggesting that we take Kant's advice, think for ourselves, and turn the searchlight of critical reason on all our cultural traditions: on Enlightenment scepticism as well as on traditional religion; on secular intellectuals - historians, philosophers, & religious studies scholars - as well as on Popes, priests, & theologians; on secular humanism as well as on Christian theology. Let us appreciate the truths, virtues, and insights, as well as the errors, sins, and blindspots, in the complex tangle of traditions that have made us what we are. Let us, in particular, refuse to be cowed into silence by the clamorous voices of Christianity's cultured despisers; let us sustain in the 21st c. the tradition of creative

Christian scholarship which Harold Turner and John Morton have so nobly represented.

Celebrating modernity: Keith Sinclair, Lloyd Geering, and the sceptical Enlightenment

At first sight Sinclair and Geering, as near to public intellectuals as New Zealanders will tolerate, appear to have little in common. Sinclair, professor of history at the University of Auckland, a proudly secular left-liberal who had no time for God or organized religion, provided the nation with historical myths of origins & identity in a wide-ranging series of books & articles that had their main impact during the 1960s, '70s, and 80s. By 'historical myths' I mean not that Sinclair fabricated histories that bore no relation to what happened in the past, but rather that an ideological agenda, a set of values & convictions, informed the way he selected, arranged, interpreted, and wrote about our past. His autobiography, *Half Way Round the Harbour* , provides clues to this agenda, which many New Zealand left-liberal writers and intellectuals in mid-century (and since) shared. Sinclair's fierce disdain for organized religion, puritanism, and conservatism - he seems to have lumped the three together as different symptoms of the same underlying disease - appears repeatedly. Collectively the three constitute for Sinclair an unholy trinity responsible for most of New Zealand's problems: the drab conformism that suppressed creativity & originality; the stifling moralism that inhibited New Zealanders from enjoying sex & other pleasures; and the conservatism that, tying us to Britain's apron strings, prevented us from developing a vibrant, distinctive, unique New Zealand identity[2] . *A History of New Zealand* (1959), arguably the most influential history of the country ever published, constituted a tract for the times, as well as a history of them. Sinclair aimed not only to reconstruct our past but also to deliver us from evil.

Before analyzing the book, I want to express a certain sympathy for Sinclair's criticisms of the New Zealand in which he grew up. The vicious puritanism he detested was no mere figment of his imagination. He tells the story, for example, of a school acquaintance being publicly humiliated for swearing by having his mouth washed out with soap. Half a century later, Sinclair's anger still smokes off the page. In criticizing his historical writing, it is not my intention to whitewash Christianity. Leading Protestant churchmen such as the Reverend Jack Somerville, a moderate liberal, saw the churches as bearing some responsibility for the problems Sinclair identified. In sympathizing with Sinclair's diagnosis of the problem, however, I do not endorse his solutions.

Sinclair's treatment of Christianity, appearing early in *A History of New Zealand* , illustrates the ideological agenda informing the narrative. The historian gave a modestly insightful, accurate, and empathic account of the role evangelical Christianity played in race relations and the politics of settlement. "The history of New Zealand was distinguished from that of previous British settlements", he declared, "by the fact that the country was annexed when the evangelical movement was at the height of its influence on colonial policy. New Zealand was intended to set the world an example of humane colonization."[3] Yet despite noble ideals, humanitarian Christians failed to make much lasting, positive impact - largely, he explains, because of their moral, intellectual, & political shortcomings.

Religion began to disappear from the story shortly thereafter as a dark 19th-c. past - gloomy, guilt-ridden, world-denying, and religious - gave way to a bright, mid-20th-century present - healthy, fun-loving, world-affirming, and secular. The trope Sinclair deployed to structure his account, of religious darkness giving way to secular light, popular amongst Enlightenment sceptics, inverted Christian conversion stories. As well as framing Sinclair's narrative as a whole, the trope also structured its parts. "Many a 'Kiwi' drinker must look into his nine ounce glass", Sinclair observed, "only to discover there the disapproving face of his Primitive Methodist ancestor". But the day of the wowser had gone, and the professor bid it good riddance. The liberated mid-20th-c. Kiwi enjoyed "a host of varied pleasures", he enthused: "sunbathing and surfing, uninhibited striptease shows," and "listening to singers or bands in suburban bars".

The "ordinary bloke", a secular soul who bore a remarkable resemblance to Sinclair, had no time for God. A "simple materialism" constituted New Zealanders' "prevailing religion", Sinclair declared approvingly; the "pursuit of health and possessions" filled more minds than "thoughts of salvation."[4]

For generations past, clergy had denounced the materialism & worldliness of New Zealanders as a sure route to moral, social, & spiritual disaster. Not to Sinclair. Quite the contrary. New Zealand, taking leave of God, led the world into the 20th century as the most advanced & progressive social democracy in the world. By bursting up the great estates, and passing factory acts, old age pensions, and votes for women, the Liberal government enhanced the lives of more of its citizens than virtually any other nation in the world. Micky Savage's first Labour government, elected in 1935, did better still, expanding the welfare state that the Liberals had begun, and providing housing, education, jobs, &

pensions - 'cradle to grave' security - for New Zealanders. The torch of progress, which Protestant America had taken from Christian Europe, passed now, in Sinclair's story, to secular New Zealand.

Sinclair's later works - biographies of William Pember Reeves and Walter Nash, studies of national identity, of relations with Australia, and of race relations after the Land Wars - elaborated many of the themes identified above. New Zealanders responded enthusiastically to the writings of an historian who depicted us, for all our faults, as the most enlightened, egalitarian, humane and progressive people in the world. Leaving behind puritanism, and religion in general, we were building a prosperous, pleasure-loving paradise in the south Pacific.

Lloyd Geering, professor of Old Testament at the Theological Hall, Knox College in Dunedin, and from the early 1970s foundation professor of Religious Studies at Victoria University of Wellington, agreed with Sinclair that Christianity had had its day. In a series of books & articles that also had their main impact during the 1960s, 70s, and 80s, he argued that modernity was extinguishing all axial age religions - Judaism, Islam, and Buddhism - as well as Christianity. Modern science, he claimed, was rendering religious truth-claims about a God beyond this world incredible, while secular nation-states, taking over schooling & social welfare from the churches, were rendering religion redundant. As modernity spread from the West to the rest, traditional religions must disappear, Geering declared. Faith's new age, which had dawned early in New Zealand, was going to be secular[5].

Yet Geering, from a Presbyterian background, expressed more ambivalence about secular modernity than Sinclair. He did not take for granted the survival of the moral seriousness, the high human values, for which Christianity had in his view served in the West as the temporary & imperfect vehicle. He saw it as his life's work to translate the deepest moral values of the dying axial-age religions into modern, secular language & concepts which everyone, secular folk and religious believers alike, could embrace. All - or at least those sufficiently "enlightened" to embrace faith's new secular age - could work together to build a peaceful, green, global human community, the differences between secularists and religious believers fading into as much irrelevance as the ugly old Protestant-Catholic sectarianism. By presenting the secular age as fulfilling and transcending Christian ecumenical aspirations, Geering appealed to religious liberals within the churches as well as morally serious secularists without. Faith's new secular age appeared in his writings as a glittering new super-ecumenism: broader, more tolerant, and more inclusive than the allegedly condescending, parochial, old Christian variety.

Though no narrow nationalist, Geering pleased local readers by depicting New Zealand as one of the most religiously & intellectually advanced societies in the world. Faith's new secular age dawned here ahead of almost anywhere else in the world, he declared in a 1980 essay. Enlightened settlers severed the ties between Church and State virtually as soon as they arrived, and so 'Old Corruption', as its critics called the Anglican Establishment, never took root. The state, secular in the sense of being religiously 'neutral', neither favoured nor discriminated against any religion. New Zealand constituted a near-paradise of religious freedom, pluralism, & tolerance, in which a powerful but benign secular state tolerated all religions equally and harmed none[6].

Things got better still, on Geering's telling, as secularization gathered pace in the 20th c. Like Sinclair, he hoped to liberate New Zealanders from the stifling religious & moral conservatism that, in his view, afflicted the nation and was killing the churches. He exhorted readers to abandon traditional, conservative approaches to moral decision-making such as theonomy, by which he meant moral decisionmaking that emphasized obedience to God's commands, and heteronomy, by which he meant taking too much notice of others' opinions. He recommended instead autonomy - the freedom to formulate one's own moral values without excessive regard for God as traditionally conceived, received doctrine, or others' opinions. This new approach soon bore fruit, at least in Geering's estimation. By the 1990s, he discerned among secular New Zealanders a 'greater moral awareness', a 'higher level of moral sensitivity, covering a much broader set of issues' than in previous, less enlightened, Christian ages[7].

The fact that Geering continued to use traditional Christian theological & moral language in his writings & sermons should not mislead us. The similarities between the country's best-known Protestant theologian and its most influential historian are as striking as the differences. Five deserve attention.

Firstly, Geering's worldview had become by the 1970s no less secular than Sinclair's. Our most controversial 'theologian' had translated theological language without remainder into the language of sociology & anthropology. All "talk and discussion about God … is really an exercise in human self-understanding", he declared; God constitutes "the symbolic embodiment of the cluster of values we have come to regard as supreme."[8] As Brian Edwards argued in a recent *Listener* article, our most controversial 'Protestant' intellectual is an atheist.

Secondly, both Sinclair and Geering wrote history in the tradition of the sceptical Enlightenment. Like Voltaire, Hume, & Gibbon, they

clubbed organized Christianity with history. While recognizing some decency and virtue in the Christian past, both scholars maximized, exaggerated, and occasionally invented, failure, ignorance, & vice. Thirdly, both men deployed history to promote their secular worldviews. Their vision of a world growing inexorably secular constituted a Procrustean bed on which they placed the past; everything that failed to fit got chopped off.

Fourthly, both wrote secular nationalist histories that depicted New Zealand as growing better while taking leave of God. Secular New Zealand appeared in the writings of both men as a worthy successor to Puritan New England, an Antipodean city upon a hill, a light shining in the darkness, a world exemplar of enlightenment & virtue. God may have died, but New Zealanders had built the Promised Land - or as near to it as human beings could come.

Fifthly, an optimistic, confident tone characterised the writings of both scholars. Traditional Christian teaching about original sin and human depravity disappeared into the past. Humankind come of age, shorn of religious illusions, confronted reality in a rational, mature, clear-sighted fashion, confident in its ability to make a good society better. In identifying similarities in the style, tone, & content of the works of Sinclair and Geering I do not want to minimize or ignore differences. Sinclair's historical writing displayed a more populist, masculinist, nationalist, anticlerical, secular, and dionysian tone. Geering's writings remained more Protestant, high-minded, and ascetic; boozing and strip shows hardly featured.

It is the similarities, however, that I want to emphasize and explore here. Sinclair and Geering influenced literally thousands of students as universities in New Zealand and throughout the West boomed. According to Elizabeth Isichei, Geering wrote and lectured students and the public "with an advocacy" that would have been "totally unacceptable in academic circles if he was, for example, a Baptist", presenting his humanism to students and the public as "the only form of Christianity acceptable to modern sophisticated people."[9] A similar point could be made about Sinclair, who had no reservations about giving his secularism free rein in teaching and scholarship. The writings of both men struck a chord with all those New Zealanders who believed, with John Lennon, that peace & love would flourish once traditional religions disappeared. The influence of both scholars almost certainly accelerated the decline of the mainline Protestant churches that, gathering pace from the mid-1960s, has continued to this day. Secular outlooks such as atheism, agnosticism, & 'no religion' flourished especially amongst younger, affluent,

university-educated New Zealanders rising to positions of power & influence in the public service, the universities, the media, and politics[10]. Members of our political and cultural elites have acknowledged the influence of both men on their beliefs and values. Catherine Tizard, for example, brought up Presbyterian, learned history from Sinclair and found Geering an inspiration, commenting to friends: "Well, if that is Christianity, then I am a Christian".[11] She went on to become Mayor of Auckland and the country's Governor-General.

Influential New Zealanders responded well to scholars who depicted New Zealand as, for all its faults, one of the most enlightened & virtuous countries on the planet. In 1985 David Lange's Labour government, which contained several ex-students or colleagues of Sinclair, awarded the historian a knighthood for services to history and to the community. Geering headed Helen Clark's Labour/Alliance government's New Year's Honours List in 2000, becoming a principal companion of the New Zealand Order of Merit. The prophets of the secular age had won honour in their own land.

Critique

In this third section I expose the historical writings of our local Enlightenment sceptics to sceptical scrutiny. I relate the silences, omissions, and interpretive errors in their scholarship to the ideological agendas behind them.

Let's begin with Sinclair's interpretation of humanitarian Christianity. In *A History of New Zealand* he argued that humanitarian Christianity, though promising much, failed to make a substantial, positive, lasting impact on New Zealand history, largely because of its intellectual, moral, & political shortcomings. "Like so many other evangelicals" he writes of CMS leader Samuel Marsden, he "reserved his pity rather for the 'poor benighted heathen' … abroad than for the heathen poor among his fellow citizens" - a half-truth that exaggerates evangelical indifference to the poor in Britain. Missionary "ideas were as destructive" of traditional Maori society "as bullets", Sinclair declared, deploying a striking, emotive & misleading metaphor that fails to explain why these allegedly destructive doctrines made little impact on Maori society during the first two decades of Protestant missionary activity. Although humanitarian Christians had "set before Great Britain a noble aim", their "ideal was not attained", he concludes, damning their efforts with faint praise. Race relations in New Zealand "soon came to resemble those on other frontiers". Humanitarian Christianity, "a plant which flourished in the hot-house of English evangelicalism", had failed to

adapt to "the harsh conditions of the colonial frontier"[12].

These judgements on the "high-minded do-gooders" as Sinclair describes them in his autobiography are short-sighted, condescending, inaccurate - underestimating their enduring legacies to the nation. The Treaty of Waitangi, which plays an important role in contemporary New Zealand culture, constitutes one of the most obvious. Drawn up by missionaries and British officials to recognize & protect Maori rights & welfare while extending British sovereignty & law over the country, the Treaty continues to have for many New Zealanders the almost sacred status that it did for those Maori and Pakeha who honoured it in the 19th c. Many, perhaps most, New Zealanders remain convinced that honouring the Treaty, and rectifying breaches of its terms, remain crucial for the welfare of Maori and the future of the country. In the Treaty, humanitarian Christianity lives.

Secondly, by depicting humanitarian Christians as largely ineffectual idealists, Sinclair failed to do justice to how tough-minded, realistic, and practical many were, as the issue of Maori depopulation, still controversial, illustrates. Maori died in large numbers as a result of European contact, their total population declining by around fifty percent over the nineteenth century, largely because they had little or no immunity to many of the diseases that arrived with the Pakeha. What scarcely any historian, including Sinclair, has acknowledged is how deeply these issues concerned British Christians during the 1830s. The Church Missionary Society, for example, the main Anglican missionary body, believed that an influx of British settlers would devastate Maori, who were flocking to mission stations during that decade. In 1837, therefore, CMS secretary Dandeson Coates tried to prevent the New Zealand Association (later Company) from obtaining a House of Commons charter enabling it to colonize New Zealand. Coates aimed if not to prevent colonization altogether then at least to delay it for half a century, in order to give Maori time & space to adapt to a modern world without losing lands & lives in a colonizing holocaust. Although the CMS failed to stop the New Zealand Company, humanitarian Christians almost certainly mitigated the worst consequences of colonization.

Thousands more Maori would almost certainly have died had not humanitarian Christians, beginning with the missionaries, provided medical help. Smallpox, for example, which devastated American Indian populations after 1492, and reduced native Indian populations in British Columbia by around 90% during the nineteenth century, had little impact on Maori largely because from the late-1840s Maori and Pakeha medical officers were vaccinating Maori against smallpox at government expense.

Later in the century Maori Christians led by Apirana Ngata, Maui Pomare, and Peter Buck, educated in the evangelical Anglicanism of Te Aute College, launched a wide-ranging successful campaign to improve Maori health. The humanitarian movement, in which Maori as well as Pakeha Christians played leading roles, had a more important, positive, & lasting impact on New Zealand society than Sinclair acknowledged.

What about Geering? Like the historicism of Karl Marx, his grand three-stage interpretation of the human story - of primal religions being replaced by axial age religions being supplanted in turn by the secular age - claims credibility & authority by presenting itself as being rooted in objective, scientific history. Geering regularly contrasts history, which he depicts as the realm of objective, reliable, factual reality, with traditional Christian theology, which he presents as the domain of speculative mythmaking mixed with just enough history to give it plausibility. The strong contrast he draws between history and theology, typical of modernist scholarship, must be seen at least partly as a rhetorical ploy designed to discredit Christian tradition and to invite credence for Geering's own tendentious reading of history. His historical writings themselves undermine the distinction he draws between history and myth. In fact he presses history into the service of a secular rationalist mythology by leaving out all the evidence incompatible with his view of the past.

In *Tomorrow's God*, for example, Geering refers to the alleged 'fact' that prior to the Copernican cosmological revolution, medieval Christians believed the earth was flat. This discredits medieval Christianity by making it look ignorant and antiscientific[12]. In fact, no "coherent intellectual tradition of flat-earthism existed in the West" during the Middle Ages; after the 5th century virtually all Christian scholars in the Latin West believed that the earth was round[13]. The myth which Geering repeats, still popular among scholars as well as the general public, was invented in 1828 by the American writer Washington Irving in his *History of the Life and Voyages of Columbus*, and popularized later in the century by the American historians J. W. Draper and A. D. White, both of whom battered the churches with bad history, as recent historians of science have shown.

This is no isolated example. Throughout his writings, Geering depicts the Church as a reactionary institution constantly at war with science. "Copernicus and Galileo caused as much consternation in Christian circles in their day as Darwin did in his", he tells us in *Tomorrow's God*, largely because "there is a deep-seated conflict between the biblical view of heaven and earth and the view of the universe opened

up by Darwin".[14] In order to sustain this view, Geering omits important historical evidence incompatible with his Church-versus-science interpretation. Both Copernicus and Galileo, he fails to tell us, were believing Catholics. Galileo, who had been friends with Cardinal Maffeo Barberini before he became Pope Urban VIII, believed he could teach the Vatican a thing or two not just about science but also about theology. As the title of a recent scholarly biography puts it, Galileo was *For Copernicus and For the Church*. His trial and condemnation must be seen as a dispute within the Church, between Catholics of diverse theological, philosophical & scientific views, not as a battle between Christianity and science. In making these points I make no attempt to whitewash the Church, whose heavy-handed attempt to silence Galileo and suppress Copernicanism the present Pope has criticised as misguided.

Geering's treatment of Darwinism's historical impact illustrates the same problem. According to Geering, Darwinism "led to a form of consciousness in which awareness of a personal God, who is both creator and benefactor, has been fading". The "role vacated by God" has been "taken over by the human species itself".[14] This claim is not entirely false. A growing number of Western intellectuals since Darwin have indeed jettisoned religion for secular worldviews. But Geering's sweeping claim that science was responsible seems at best problematic in light of recent scholarship. Darwin's own loss of faith, for example, owed little to his science. He rejected as 'damnable doctrine' the idea that unbelievers such as his own father would burn in hell for eternity; the death of his beloved 10-year-old daughter Annie shattered the last remnant of his faith.[15]

Across the Atlantic, in nineteenth-century America, scientists engaged with evolution with hardly any religious consequences. Ron Numbers, a leading American historian of science, examined the worldviews of some 80 leading natural scientists, mostly geologists, biologists, and anthropologists, who won election to the National Academy of Sciences, the most prestigious scientific body in America, for the quality of their research. Contrary to what Geering would lead us to expect, engaging with Darwinism had virtually no impact on their religious beliefs. Not a single one of these 80 scientists substantially altered his worldview as a result of embracing evolution. The great majority remained church-affiliated Christians of some variety; the atheists and agnostics, a small minority, had abandoned Christianity before embracing evolution.[16]

In New Zealand, too, theistic evolutionism was well-represented within the scientific community. F. W. Hutton, for example, first profes-

sor of natural science at the University of Otago and of biology at Canterbury College, wrote one of the first reviews of the *Origin of Species* ever published. Hutton's enthusiastic & insightful endorsement of evolution delighted Darwin. Hutton did more than any other scientist to make evolution paradigmatic within New Zealand science & society, converting both the Anglican Bishop of Dunedin and the Reverend William Salmond, the south's leading Presbyterian theologian, to evolutionary views. Throughout a long productive career, Hutton, son of an Anglican vicar, a life-long Anglican churchman, and a lay theologian, presented evolution as God's method of creation. Human moral & spiritual evolution, imperfect & incomplete in this life, would continue in a spiritual existence beyond death. Many New Zealand men of science in the 19th and early 20th centuries - James Hector, Julius Haast, George Grey, G.M. Thomson, A.P.W. Thomas, Walter Buller, Thomas Kirk, and Leonard Cockayne - held similar views[17]. Theistic evolutionism has constituted a long-standing tradition in New Zealand, ably developed in the late 20th century by John Morton. The fact that such scholars as Sinclair & Geering ignore this tradition tells us more about their blinkers than it does about our past or present.

My research on missionary science further undermines Geering's idea that traditional Christianity faded away in the face of the inexorable advance of science. The Christian missionary movement brought modern science to the world during the 19th & 20th centuries. Africans, Indians, Chinese, & Pacific Islanders were far more likely to have their first encounter with Western science in a missionary hospital, school, college, or museum than in a secular context. As well as spreading Western scientific knowledge & practice, several missionaries made important theoretical contributions. One of the world's leading evolutionary theorists at the turn of the century, for example, was an American Protestant missionary, John Thomas Gulick who, stationed in Hawaii, wrote a series of papers on land snails that drew attention to the significance of geographic isolation in the evolution of new species[18].

Religious belief among leading American scientists has held steady over the twentieth century. In 1997 *Nature* reported that around 40% of leading American scientists believed in 'a God to whom one may pray in the expectation of receiving an answer' - a proportion that had not changed since the 1920s[19]. Several of the leading architects of the modern neo-Darwinian synthesis of natural selection with Mendelian genetics that occurred in the 1930s and after, such as R.A. Fisher, Theodosius Dobzhansky, and, more recently, Francisco Ayala, have been Christians of one sort or another.

Christianity continues to find distinguished advocates amongst 21st-c. scientists. John Polkinghorne, Fellow of the Royal Society, former Cambridge Professor of Mathematical Physics, and an ordained Anglican priest, has published a series of books exploring the world from points of view informed by the latest, most counter-intuitive quantum physics and by orthodox Anglican Christianity[20]. Francis S. Collins, leader of the International Human Genome Project, in February 2001 described sequencing the human genome as "an exhilarating moment of being able to perceive incredibly elegant information about how we're put together", information which "God knew before and now we have a chance to know it too". A professing Christian, Collins found science and faith to "coexist quite handily inside myself and many other people I know"[21].

Christianity is being taken more seriously than ever by thoughtful & open-minded interpreters & popularizers of science. Michael Ruse, a leading historian & philosopher of science, compared "a fairly full-blooded version of Darwinism" with a "fairly traditional and full-blooded reading of Christianity" in a recent book entitled *Can a Darwinian be a Christian?* Ruse's answer: 'Absolutely!"[22]. Stephen Jay Gould's 1999 book *Rocks of Ages* argues that the world requires both science and religion. Unnecessary conflicts between the two can be avoided if science and religion are conceived as non-overlapping magisteria, with science recognized as authoritative interpreter of nature, and religion holding sway over human values, morality, & spirituality[23].

Even amongst Western scientists & intellectuals, then - the most secularized group in the contemporary world - Christianity has remained stubbornly alive, indeed well-represented. Outside Western elites, of course, traditional religions flourish more vigorously than ever. Islam - resurgent in the Arab world, South-East Asia, and parts of Europe - plays a powerful role in world politics. Christianity is booming in sub-Saharan Africa, Asia, and the ex-Communist world. Harold Turner discovered all this for himself many decades ago, of course, and was thereby inoculated against the god-is-dead fad of Eurocentric Western intellectuals. The apparently cosmopolitan, secular outlook of Western intellectuals such as Geering & Sinclair, when placed in the context of a vibrantly religious wider world, begins to look small, blinkered, & parochial. White Western intellectuals alienated from Christianity confuse their story with the world's.

Other silences and omissions in the histories of Geering and Sinclair strike me as worth exploring. Let's cast a critical eye at the secular age as it dawned in New Zealand. How did New Zealand's

secular state actually behave? What happens when we stop celebrating modernity and look beneath the rosy rhetoric of Geering & Sinclair?

Both scholars had little but praise for the state. For Sinclair, the state, when run by left-liberals like himself, played an almost messianic role in New Zealand history, levelling the playing field, equalizing opportunity, and creating remarkable peace, security, & prosperity. Geering's state appeared equally benevolent, adjudicating with remarkable fairness between competing religions, discriminating against none. What did these flattering accounts of New Zealand's secular state leave out?

Geering's depiction of the state as religiously neutral, impartial, favouring no religious group over any other, seems complacent. In fact, New Zealand's 'secular' state has regularly silenced, condemned, even persecuted religious 'Others'. During the Crown Colony period, and especially after 1852 when Pakeha settlers acquired responsible government, settler politicians warred against Anglican church leaders, missionaries, & Maori Christians largely because the latter groups, championing Maori rights & welfare and the Treaty of Waitangi, obstructed quick & easy colonization. Later, in 1881, the settler state sent 500 armed troops into Te Whiti's Maori Christian community at Parihaka, arresting and imprisoning without trial Te Whiti, Tohu, and other leaders. In 1916, an armed police party invaded Rua Kenana's millennial community at Maungapohatu, killing the son of the self-styled Maori messiah, and arresting Rua.

During the First World War, state officials punished Christian & other conscientious objectors to military service, sometimes brutally. For almost a century after the passing of the 1877 Education Act, which set up a state-run system of 'free, secular, and compulsory' primary schools, New Zealand Catholics saw the state as crypto-Protestant, fundamentally hostile to their beliefs about the importance of a Catholic education. Geering would not, I think, approve of state policies in most of these cases, but they raise disturbing questions about his rosy account of the secular New Zealand state. If our secular state has indeed waged a long, hard, and when necessary ruthless campaign to crush serious Christian dissent, this places the writings of both Geering and Sinclair in a new light. Their flattering depictions of the rise of the secular state, and the silences in their histories, appear just what the secular nation-state required. Both, not necessarily deliberately, served the state by providing effective solutions to its long-standing Christian problem.

If we accept Geering's arguments, significant Christian criticism of New Zealand's public culture based on a combination of Scripture,

Christian tradition, right reason, and religious experience, is no longer possible. Our most controversial Protestant 'theologian' has banished recognizably Christian discourse from the public square. No longer can New Zealand Christians criticize the state on the basis of any form of Christian tradition. Only secular arguments & reasoning are allowed. Geering himself criticizes government policies in various ways, to be sure. But mild, occasionally courageous, left-liberal secular humanism poses no radical challenge or threat. Geering has performed the invaluable service of eviscerating Christian tradition from within. Does this help explain why he topped the New Year's Honours list?

Keith Sinclair, similarly, downplayed or ignored those dimensions of our past that would have undermined his reading of New Zealand history as progress from Christian darkness to secular light. Like Geering, he downplayed or ignored flaws & problems in the secular left-liberal tradition with which he identified. Though aware of anti-Chinese racism in our past, he dismissed it as irrational, attaching no significance to the fact that several of his heroes, such as the politicians William Pember Reeves & Robert Stout, freethinking secular liberals, played leading roles in the campaign to keep New Zealand white by keeping Chinese out. Similarly, Sinclair virtually ignored the eugenics movement which burgeoned in New Zealand, as elsewhere in the West, during the first decades of the 20th century.

Eugenists, as they called themselves, aimed to improve the human species by selective breeding. Here again, secular liberals such as Duncan MacGregor, Robert Stout, John Macmillan Brown, & William Benham (professor of biology at Otago University) played prominent roles. As early as1876, MacGregor, professor of Mental & Moral Philosophy at the University of Otago, outlined his solution to the problem of poverty threatening New Zealand. Hopeless drunkards, criminals & poor people who had repeatedly tried and failed to reform should be 'deprived of their liberty until they die' by isolating them in labour camps and preventing them from reproducing. The state had a duty to prevent 'defectives' from 'injuring society by their crimes' or by having children to 'inherit their curse,' he declared. MacGregor left Otago for Wellington in 1885 to become Inspector General of Hospitals & Lunatic Asylums, the most highly paid and one of the most senior public servants in the 1890s Liberal Government[24]. Others proposed faster solutions. The aptly-named Elizabeth Gunn, an Otago University-educated physician and school medical officer who inspired the national Health Camp Movement, told the government's 1924 Committee of Inquiry into Mental Defectives & Sexual Offenders that, after testing intellectually handicapped children, it should dispose of hopeless cases in

a ‘lethal chamber’. Here, as elsewhere in the West, the Catholic Church condemned such proposals as attempts to ‘out-Herod Herod’ in a latter-day ‘slaughter of the innocents’[25].

Nationalism had largely supplanted Christianity as the actual religion, the ultimate concern of these secular liberals. Widely admired by contemporaries as enlightened, progressive patriots, they aimed to build a strong, prosperous, cohesive nation, a newer & better Britain, in the Antipodes. Doing so required, in their view, excluding all those social failures and racial misfits, particularly Asiatics & ‘unfit’ whites, who threatened their ideal society. New Zealand’s secular liberals have sometimes pursued their ideals in élitist and punitive ways.

One final context helps explain why the writings of Sinclair & Geering won favour with those rising to power during the last third of the century. Both men grew up and built remarkable careers in a New Zealand we have lost. For much of the 20th c., and especially between the late-1940s and the mid-1970s, New Zealanders enjoyed one of the highest material standards of living in the world. The welfare state expanded, steadily if erratically, during these golden decades to become one of the largest, relative to the country’s size, in the world. Growing up and establishing careers & families in the 1940s ‘50s & ’60s both Geering and Sinclair enjoyed its largesse, as the welfare state directed its resources toward their generation of children and young adults.

During the 1970s & 1980s, however, as the welfare state aged, the same favoured generation - those born between about 1920 and about 1945 - continued to receive a disproportionate share of its resources. Our political leaders turned a welfare state for the young into a welfare state favouring the middle-aged & elderly. Politicians were too busy currying favour with voters to pay attention to the crucial question of how the welfare state should operate over long periods of time to ensure fairness between generations. More disturbingly, academics who proclaimed themselves society’s critic & conscience, also kept silent. Sinclair, for example, who had spent much of his scholarly career celebrating the secular New Zealand welfare state, raised no hard questions about it late in his career. Nor did Geering. Both men, part of the lucky generation, appeared unwilling even to raise the possibility that the New Zealand welfare state was devouring its children. To do so would have raised disturbing questions about the values and worldview of the intellectual & cultural leaders of their generation. Sinclair & Geering won honour & esteem by not doing so. This broader economic & political context places in a new, and less flattering, light Sinclair’s attacks on organized religion, traditional morality, & puritanism, and

Geering's exhortations to moral autonomy and the development of 'ultimate concerns' without regard to traditional Christian sources of authority[26].

It is to the credit of John Morton and Harold Turner that, bringing Christian tradition into a serious and fruitful engagement with modern science & critical scholarship, they refused to sacrifice their faith to the spirit of the age. They and Christians like them have played more important roles in the history of New Zealand, the West, and the world than Christianity's cultured doomsayers have acknowledged. Let us honour their achievements. We are all in their debt.

—-

[1] Paul Smith, ed., *Lord Salisbury on Politics*, London, 1972, p.19.
[2] Keith Sinclair, *Halfway Round the Harbour: An Autobiography*, Auckland, Penguin Books, 1993.
[3] Keith Sinclair, *A History of New Zealand* London: Penguin Books 1959, p.130.
[4] *Ibid.* pp.278, 288.
[5] See, for example, *God in the New World* London: Hodder & Stoughton, 1968; *Resurrection: A Symbol of Hope* London: Hodder & Stoughton, 1971; *Faith's New Age* London: Collins, 1980; *Tomorrow's God* Wellington: Bridget Williams, 1994.
[6] Lloyd Geering 'New Zealand Enters the Secular Age,' *in* Christopher Nichol & James Veitch (eds.) *Religion in New Zealand* Wellington 1980, pp. 238-263.
[7] *Ibid.*, p.252.
[8] *Tomorrow's God* pp.144-5, 155-6.
[9] Elizabeth Isichei 'Some Ambiguities in the Academic Study of Religion' *Religion 23* 379-390 (1993) p.385
[10] Michael Hill, 'The Cult of Humanity and the Secret Religion of the Educated Classes' *New Zealand Sociology* 2:2 (1987), pp.112-127; Michael Hill and Wiebe Zwaga, 'The "Nones" Story: A Comparative Analysis of Religious Nonalignment' *New Zealand Sociology* 4:2 1989), pp. 164-185.
[11] Neville Glasgow, ed. *Directions: New Zealanders Explore the Meaning of Life* Christchurch: Shoal Bay Press, 1995, p.28.
[12] See, for example, *Tomorrow's God*, p.1.
[13] Robert Schadewald 'Flat-Earthism' *in* G. Ferngren (ed) *The History of Science and Religion in the Western Tradition* New York: Garland, 2000, pp.359-361.
[14] *Ibid.* p.3.
[15] Adrian Desmond & James Moore *Darwin* London: Michael Joseph 1991, p.375-390.
[16] Ronald L. Numbers *Darwin Comes to America* Cambridge: Harvard University Press 1998, pp.24-48.

[17] J. Stenhouse 'Darwinism in New Zealand 1859-1860' *in* Ronald L. Numbers & John Stenhouse (eds.) *Disseminating Darwinism: The Role of Place, Race, Religion, and Gender* New York: Cambridge University Press 1999, pp.61-90, pp.71-79.
[18] See John Stenhouse 'Missionary Science,' *in* D. Livingstone & R. Numbers (eds.) *Science in National and International Context* Cambridge University Press (forthcoming).
[19] Edward J. Larson & Larry Withan 'Scientists are still keeping the faith' *Nature 386* 435 (1997)
[20] See, for example, John Polkinghorne *The Faith of a Physicist: Reflections of a Bottom-Up Thinker* Princeton University Press 1994.
[21] 'The World in a Grain of Sand: Genome Project center stage at AAAS' *Research News in Science and Theology 1* (8) 16 (April 2001).
[22] Michael Ruse *Can a Darwinian be a Christian: The Relationship between Science and Religion* Cambridge: Cambridge University Press 2001, p.217.
[23] Stephen Jay Gould *Rocks of Ages: Science and Religion in the Fullness of Life* New York: Ballantine 1999.
[24] D. MacGregor 'The Problem of Poverty in New Zealand' *New Zealand Magazine 1* (7) 1876, pp.317, 320.
[25] See further Philip J. Fleming 'Eugenics in New Zealand, 1900-1940' MA thesis, Massey University 1981.
[26] See further David Thomson, *Selfish Generations: The Aging of New Zealand's Welfare State*, Wellington: Bridget Williams, 1991.

The Galileo affair

or

How NOT to engage in the Theology/Science debate

Stephen May

Presented abbreviated as a lecture, with 'Star Trek' video excerpts,
at the symposium 'Science and Christianity'
to honour Harold Turner and John Morton, Auckland 01-4-21.

Introduction: the warfare model

The *Star Trek: Voyager* episode 'Distant Origin' is a parable of the supposed conflict between science and Christianity, a none-too-subtle retelling of the Galileo affair with a few allusions to evolution and Darwinism thrown in for good measure[1]. As such it conforms to all the stereotypes we have come to expect of these tales. To quote a children's encyclopedia[2]: 'While the Bible said that everything moves round the earth … Galileo's observations showed that the earth moves around the sun.' As we shall come to see, whether this is true is of the essence of the matter.

As is pointed out by John Brooke and Geoffrey Cantor[3], this verb 'see' (just used) has a particular potency in how the Galileo affair is interpreted. It is commonly presumed that what Galileo 'saw' was indisputable. That some people refused this truth paradoxically brings echoes of the Bible: Jesus too condemned the Pharisees for refusing to see, for being (as the preachers put it) full of 'spiritual blindness'[4]. So too in the *Voyager* version: Galileo-like scientist Gegan optimistically declares 'the evidence will speak for itself'. However, his hearers do not wish 'to see'. Later he is encouraged by the prophetic words of his colleague: 'Eyes open!'.

As Brooke & Cantor put it[5]: "Galileo's forced recantation in June 1633 has been a potent, perhaps the most potent, symbol of the suppression of truth in the name of religion. The actor Richard Griffiths, who had been playing the part of Galileo in Brecht's play, said '[b]y stifling the truth,

which was there for anyone to see, the Church destroyed its credibility with science" (italics mine).

Thus too Colin A. Ronan[6]: "Galileo does stand as a classic example of the evils of a totalitarian regime. He was persecuted [by men who] were afraid of the power of independent thought. Galileo … cut right across the religious authority of the Church … [His persecutors] took the one course they could: they stifled the dissension at its source."

And again, Paul Liben[7]: "In centuries past, science's boundaries were continually threatened with invasion by the forces of institutionalized religion. One of the most egregious examples of this was the persecution of Galileo at the hands of the seventeenth-century Roman Catholic Church … [This is] an example of the bullying of science by those having an apparent stake in the upholding of a particular religious world view."

Example after example could be given of this standard interpretation, Jacob Bronowski's urbane retelling of the story in his *The Ascent of Man* being only one of the most famous. The *Star Trek: Voyager* story fits into every modernist category. Its 'grand narrative' could be depicted, without much exaggeration, as a simple contrast between the forces of right and wrong, 'the guys with the white hats and the guys with the black hats' – and the place of the forces of religion and science are clear. On the one hand we find lined up science, knowledge, evidence and 'proof', objectivity, truth, progress, selfless heroism and courage; on the other, 'doctrine', faith (or ignorance, whichever way you wish to put it), prejudice, wishful thinking, ancient myth, stagnation, intellectual & moral cowardice, and a self-interested clinging to power. Does it not bring tears to your eyes just to hear it?

It has been said that every myth about the relation of science and theology is wrong, and this is one of the 'wrongest'! This grand narrative is so simplistic that it just about sits up and begs to be 'demythologised' - and more recent studies are beginning to do just this[8]. Almost every assumption made about this familiar tale is devastatingly inaccurate. I have said in my title for this paper that the Galileo story is a tale of how not to engage in the theology-&-science debate, and that remark cuts both ways. It is true of the errors the Church made at the time; it is equally true of the way in which the episode has been interpreted - as a myth of the heroes of science fighting the obscurantist religious foes of truth.

This myth can be summed up in the words of T.H. Huxley writing about *humanity*'s 'distant origins' in the other historical allusion of the *Star Trek: Voyager* tale - evolution (and in rather anti-Semitic vein, we might note):

> In this 19th Century, as at the dawn of modern physical science, the cosmogony of the semi-barbarous Hebrew is the incubus of the philosopher and the opprobrium of the orthodox. Who shall number the patient and earnest seekers after truth, from the days of Galileo until now, whose lives have been embittered and their good name blasted by the mistaken zeal of Bibliolaters? Who shall count the host of weaker men whose sense of truth has been destroyed in the attempt to force the generous new wine of Science into the old bottles of Judaism, compelled by the outcry of the same strong party?
>
> It is true that if philosophers have suffered, their cause has been amply avenged. Extinguished theologians lie about the cradle of every science as the strangled snakes besides that of Hercules; and history records that whenever science and orthodoxy have been fairly opposed, the latter has been forced to retire from the lists, bleeding and crushed, if not annihilated; scotched if not slain. But orthodoxy is the Bourbon of the world of thought. It learns not, neither can it forget; and though, at present, bewildered and afraid to move, it is as willing as ever to insist that the first chapter of Genesis contains the beginning and the end of sound science; and to visit, with such petty thunderbolts as its half-paralyzed hands can hurl, those who refuse to degrade Nature to the level of primitive Judaism[9].

Andrew D. White, John Draper and others are notorious for the way in which they gleefully propagandised the 'warfare' model of the relationship between Christianity and science to expose what they regarded as the notoriously obscurantist, illiberal and inevitably reactionary nature of Christianity when faced with the challenges of scientific insight and technological capacity. More recently, this model is still purveyed by such widely read and influential scientific popularists as Carl Sagan, Richard Dawkins and Peter Atkins, all evangelists for the cause of science and haters of what they regard as the inevitably polluting ignorance and vested interest of 'organised religion'.

The Galileo Affair: a narrative

Before analysing the standard model, it is necessary to give some brief historical sketch of the affair. The prevailing cosmology up to Copernicus was that of Ptolemy. It had reigned largely unchallenged for almost 1500 years. It had been welded by Medieval Christians with the physics of Aristotle - not completely harmoniously, a fact of which they were well aware. A fundamental hierarchical distinction was made by which the Aristotelian 'philosophy of nature' purported to understand the structure of the physical world and the cause of the motions of celestial objects, whilst Ptolemaic cosmology was merely a mathematical construct, and as such was used to calculate celestial motions without being regarded as fundamentally 'realistic'[10]. Part of Galileo's (and, before him Copernicus') novelty was to claim that mathematics described how the universe actually *was* [11]. By contrast, people before viewed Ptolemy's epicycles as a convenient fiction, which nevertheless worked well in predicting the movements of the planets and thus navigating sailors from Portugal to the Azores[12].

As has been well observed, Copernicus' model, published in *De Revolutionibus Orbium Coelestium* (On the Revolution of Heavenly Bodies) in 1543, was in many ways neither an evident advance nor simpler. It actually required more epicycles, for example, largely because Copernicus clung to the Aristotelian assumption that because the planets were in the perfect heavens, they inevitably moved in perfect circles[13]. It was not till the publication of the *Astronomia Nova* in 1609 that Kepler's First Law of Planetary Motion revealed that they moved in ellipses[14]. This revolutionary and most reluctant discovery of Kepler's was never accepted by Galileo[15]. The Lutheran Andreas Osiander notoriously added a Preface to Copernicus' work, saying that it was only a hypothetical model – '[b]eware if you expect truth from astronomy lest you leave this field a greater fool than when you entered'[16]! Although this was regarded as the worst form of betrayal by Copernicus' friend Giese, it both fitted into the Medieval approach to the role of mathematics and made Copernicanism both discussable and moderately acceptable[17]: by the time of Galileo's trial, even Cardinal Bellarmine (his interrogator in 1616) said that mathematically it was preferable to Ptolemaic cosmology[18]!

Various deathknells were sounded for Ptolemy by the discovery in 1572 of a nova and in 1577 of a comet (both by Tycho Brahe), and by Galileo's telescopic observations of 1609-10. According to Ptolemy, the heavens

were supposed to be unalteringly perfect & regular; a nova introduced change, whilst the comet would have pierced through the crystalline spheres which supposedly held the planets. When Galileo turned his telescope on the heavens, possibly following the lead of others, he found satellites around Jupiter (which contradicted the supposition that everything revolved around the Earth), larger numbers of stars than the human eye could see unaided (which tended to contradict the notion that they were there for our edification), and craters on the Moon and spots upon the Sun (which demolished the notion that the heavens were without blemish). Where perfection now? Owen Gingerich[16] quotes John Donne's shocked reaction: "Tis all in pieces, all coherence gone".

Galileo's observations reinforced his earlier sympathies for Copernicanism and led him – now a star feted wherever he went – to begin agitating for a change in the official Catholic position on Copernicanism. In some ways this was counterproductive, pushing the Church into a reactive & harder line. As became all the more the case during the (religious) Thirty Years War 1618-1648, Catholicism tended to define itself over against Protestantism, and the fear of 'looking weak' was always lurking[19]. If earlier Copernicanism might have been largely ignored because it was only hypothetical and in any case the Church had bigger fish to fry (so to speak!) - *viz*. the Reformers - later equivocation against Galileo might have been taken as loss of nerve. Giordano Bruno was burnt in 1600 for heresy, and the Instrument for the Propagation of the Faith founded in 1622[20].

It was clear that trouble was coming. Galileo's *Letter to the Grand Duchess Christina* tried to head it off with an exegesis of Scripture: in this he famously quoted the aphorism of the Vatican Librarian, Boranius – "that the Scripture tells us how to go to heaven, not how the heavens go". This was entirely in tune with Augustine[21], who had observed that "we do not read in the Gospel that the Lord said: I will send you the Paraclete to teach you how the Sun and the Moon move. Because he wished to make them Christians, not mathematicians!" The Church, by contrast, was to decide the Scriptures did indeed tell us how the heavens go – and it was 'part of doctrine'.

The remarkable Dominican Thomas Campanella wrote *A Defence of Galileo* in which he strongly defended Galileo's freedom to pursue his new discoveries, even whilst he personally thought he had not proven his point and was in fact wrong! Paolo Foscarini's *Letter on the Motion of*

the Earth positively tried to serve the Church by arguing that if the new astronomy were proved in the near future, the Church would (as both Augustine and Aquinas had suggested) have to reinterpret the Biblical passages that might seem to contradict them. Meanwhile Galileo was trying to prove that Catholics were at the forefront of new knowledge[22]. However, by sending a copy of his essay to Cardinal Bellarmine, the leading theologian of the day, Foscarini may have provoked a definitive response. When Bellarmine's reply stated that 'the movement of the sun and the immobility of the earth' were indeed matters of faith in the full Tridentine sense, Galileo and his supporters were driven into a corner. For at least one commentator[23], the debate had effectively ended.

A Decree of the Congregation of the Index was published on 5 March 1616, announcing that Copernican astronomy had been declared false because contrary to Holy Scripture. Pope Paul VI instructed Bellarmine to meet with Galileo and not only inform him of this but enforce his agreement. What exactly happened at this meeting remains a matter of dispute, the record not helped by Bellarmine's death in 1621. Galileo cannily asked for a letter from Bellarmine three months after the meeting to summarise its content; this only says that Galileo was informed of the pending decree condemning Copernicanism, with the result that it 'cannot be defended or held'.

For the next 17 years, Galileo stayed out of harm's way (at least in this regard), largely by working on other issues. He did, however, begin quietly to write a new book on the old dispute, elated – like other 'progressives' - by the fact that his friend Maffeo Barberini had been elected Pope as Urban VIII in 1623[24]. On six occasions, Galileo met with Urban, and somehow decided as a result that he had tacit approval to write a detailed analysis of the debate on cosmology. He seized on the notion of a *Dialogue Concerning the Two Chief World Systems* which, when published in 1632, immediately caused a sensation. This was largely because the claim to neutrality was self-evidently absurd. There are three characters: Salviati 'a brilliant savant', clearly Galileo's mouthpiece, given the best lines and the most convincing arguments; Sagredo, 'an intelligent amateur', generally won over by Salviati's eloquence; and lastly, Simplicio, a good-humoured buffoon, defender of Aristotle & Ptolemy, who (to quote Koestler) 'fulfils the role of the clown who is kicked in the pants'[25].

What proved particularly catastrophic was that Galileo – with a stupidity hard to believe – put into the mouth of Simplicio the argument that the

Pope himself had insisted should be included, namely that God was free because of his omnipotence to do anything he liked.

As Koestler puts it again: 'It is Simplicio who, after being shown up as an ass over and again, trots out at the very end Pope Urban's argument as coming "from a most eminent and learned person, and before whom one must fall silent"; whereupon the other two declare themselves silenced by "this admirable and angelic doctrine" and decide "to go and enjoy an hour of refreshment in the gondola that awaits us".' Whether Galileo really intended the Dialogue to end with what Koestler calls 'what can only be described as a rude noise at the Pope' is hard to credit, but this is certainly the way it was interpreted. The situation was not helped by the fact that, although Galileo claimed Simplicio to be based on Simplicius, a 6th-c. commentator on Aristotle (a matter to which we will return), the word means in Italian precisely what we imagine it means – simpleton!

The Pope, furious, said Galileo had not feared to 'make game of him', a fact that Galileo put down as 'the primary cause of all my troubles'[26]. Koestler perceptively comments that Urban's perilous adulation had turned into the fury of the betrayed lover; Mario Biagoli (in a revisionist interpretation that emphasises Galileo as disputatious courtier[27]) 'suggests that the rise and fall of Galileo conforms to a well documented pattern in the courtly life of the period: the rise and fall of a favourite, whose fall, once triggered, becomes absolute, swift and inexorable. A characteristic of many such falls was the pretext spelled out by the patron: he had been betrayed.'

And this indeed is how the Pope looked at matters: he had been not simply mocked but deceived. An injunction from the Holy Office came to light, purporting to be a true record of what had happened in the meeting between Galileo and Bellarmine. According to this – and contrary to what Galileo had been telling him - Galileo had been warned specifically not to teach or defend Copernicanism *in any way whatsoever*, either verbally or in writing. Whether this injunction was a forgery (thus Bronowski, for example) or not is still unclear - but it persuaded the Pope. A trial followed in 1633 with the consequences that are well known. Galileo was publicly humiliated (the Pope wanted revenge); Galileo pretended never to have supported Copernicanism but was forced to recant; he was forbidden to teach or research, and was placed under house arrest. In 1642, he died. Scholarship moved north, particularly to England and the Netherlands[16]; Descartes left France for Sweden.

The Myth

So let us look at exactly what those assumptions are.

1. The evidence

First of all, was the evidence indisputable? Was it there for anyone to see? In fact, it was far from so. Galileo consistently refused to take seriously Tycho's 'compromise' cosmology, which was the most popular during the period, seemingly 'saving the appearances' whilst conforming to Aristotelian natural laws. According to this, the sun revolved around the earth, but the other planets revolved round the sun. The phases of Venus, which Galileo observed with his telescope in 1610, were argued by Galileo to unquestionably prove the Copernican thesis, yet in fact they could be used to substantiate the Tychonic one equally well. We know (with hindsight) that Galileo was right, but at the time the evidence certainly did not point unequivocally in his direction. Stellar parallax would have indicated the error of Ptolemy's cosmology but since the stars are so far away, a fact anticipated by Aristarchus of Samos (310-230 BC!)[28], it did not indicate this till 1838 when sufficiently precise measurements became possible[29]. Galileo's crowning argument was tidal flux but - as Koestler savagely indicates - this was in fact completely wrong. Galileo's presentation of the Copernican scheme in his *Dialogue* smooths over all its problems, to the point where some have argued that none of the positions presented there were remotely accurate. Owen Gingerich describes an imaginary congress of the International Astronomical Union in 1592 pronouncing that 'whilst about half of them accept Tycho's view, ... the rest say it does not matter since all such geometric schemes are only hypothetical anyway'[16].

A lot, however, hangs on the notion of proof, combined with the Medieval view of hypothesis. There is a lot to indicate that Bellarmine and Galileo, to name only two, were operating with very different notions of what this meant. In many ways, Augustine - much quoted by Galileo but not wholly in support of him - underlies the whole debate. He had written in a much-quoted passage in a commentary on Genesis:

> Usually even a non-Christian knows something about the earth, the heavens, and the other elements of this world ... and this knowledge he holds to as being certain from reason and experience. Now, it is a disgraceful and dangerous thing for an infidel to hear a Christian, presumably giving the meaning of Holy Scripture, talking nonsense on these topics; and we should take all means to prevent such an embarrassing situation, in

> which people show vast ignorance in a Christian and laugh it to scorn. The shame is not so much that an ignorant individual is derided, but that people outside the household of the faith think that our sacred writers hold such opinions, and, to the great loss of those for whose salvation we toil, the writers of our Scripture are criticised and rejected as unlearned men.[30]

The problem with the model proposed by Augustine was that the Church was required to give preference to biblical views over science when scientific laws and theories are not completely certain. Galileo spent his life searching for the one certain proof of Copernicanism. Bellarmine acknowledged that if it had been found, he would have been obliged to reinterpret Scripture accordingly. However, since he believed it had *not*, he had to follow the Fathers and the apparent literal sense of Scripture. Thus was fulfilled the inherent danger of Augustine's model, that the Church could be left defending an evidently false idea, when a tentative scientific claim became fully proven.

In addition there was some confusion over the meaning of hypothesis. Was it, in the Medieval sense, something estranged from reality, like all mathematics, or was it, in the more modern sense, a theory which has not yet been proved? Galileo followed the modern meaning; Bellarmine and others seem to have been hesitating between the two.

2. Galileo and faith

Secondly, as recent Catholic treatments of Galileo have indicated, Galileo was far from being hostile to the Church, and was in fact profoundly devout. Thus Annibale Fantoli's recent *magnum opus* from the Vatican Observatory is entitled *Galileo: For Copernicanism and for the Church* (a double-edged title, this) and Dava Sobel's *Galileo's Daughter* brings out similar points.

3. Galileo tortured and imprisoned?

Similarly, modern treatments have tended to downplay the horror of Galileo's trial. He has been said to have received 'honourable detention and a mild reproof'[31]. Certainly the form of his house arrest was fairly luxurious: during the trial a five-roomed flat in the Holy office, overlooking St. Peter's and the Vatican gardens and armed with his own personal valet and major domo, and afterwards sojourns in villas & palaces preceding retirement to his farm and house in Florence. Even the reading of the penitential psalms was delegated to his daughter, Sister Marie Celeste, a Carmelite nun. As for the stories of torture by the

Inquisition, he received not even the *territio realis* (the showing of the instruments of torture), as Bronowski alleges, but only the *territio verbalis* [32]. Koestler is at pains to remind us that Kepler's aged mother did receive the *territio realis* for suspicion of being a witch[33].

4. Galileo a modest hero?

It also seems clear that Galileo's personality was one of unswerving obstinacy and lack of tact. Convinced of his own righteousness, he set out to intimidate the opposition into submission. Unfortunately, when the opposition consisted of his threatened peers and self-styled superiors, such a course was doomed to disaster. Galileo's unique ability to make enemies through his arrogance and sarcastic wit served him very ill. In Urban VIII he had to deal with a man of vanity equal to his own. Moreover, one of the Aristotelian Jesuits whom he had pilloried 25 years earlier was to be the Inquisition's Commissary General at Galileo's trial in 1633[34]. Galileo occupied some of the time following the placing of Copernicus on the Index in 1616 by engaging in a savage fight about comets with another Jesuit, Grassi. The conclusion of this debate (Galileo's famous *Il Saggiatore*, The Assayer, 1623) saw him cast 'in the role of the toreador, and the consensus was that Father Grassi had to be dragged out of the arena sprawled on his back'[35]. The result of this was that the Jesuits as a body turned against Galileo. The conflict with the Aristotelians was inevitable: that with the Jesuits was not. Father Grienberger, who succeeded Clavius as head of the Roman College, was to remark later that "if Galileo had not incurred the displeasure of the Company, he could have gone on writing freely about the motion of the earth to the end of his days". For Koestler, the critical point is that the attitude of the Roman College – by no means a reactionary body, one that had already moved considerably to question and reject key Aristotelian concepts – "in general changed from friendliness to hostility, not because of the Copernican views held by Galileo, but because of his personal attacks on leading authorities of the order".

Here it is doubly ironic that in his main contention about comets – that they were optical illusions only – Galileo was thoroughly wrong. His motivation for this dispute seems to have been wounded vanity, that (in his own eyes, at least) his own discoveries had been insufficiently recognised[36]. *The Assayer* begins with a tirade against all who tried to rob Galileo 'of the glory of his achievements' – to whose ranks he adds Marius van Gunzenhausen, the discoverer of the spiral nebula in Andromeda (the first nebula observed). Thus he writes: "You cannot help it, Signor Sarsi [Grassi] that it was granted to me alone to discover all the

new phenomena in the sky and nothing to anybody else. This is the truth which neither virtue nor envy can suppress".

The absurdity of this claim is inexcusable. Just as in other areas, Galileo was probably not even the first European discoverer of sunspots (the credit lies equally with Scheiner and Lystat, Thomas Harriott and Johannes Fabricius, and Chinese astronomers are now known to have observed sunspots centuries earlier)[37]. Tycho Brahe, one of the most disciplined & rigorous of all astronomical observers, was ridiculed for his 'alleged observations' and comets were described as 'Tycho's monkey-planets'[37]. The fact that his own telescopic discoveries were not rejected out of hand – a supposed display of its properties failed to impress other dignitaries[38] - and much owed to the unquestioning and immediate support of the great Johannes Kepler, the Imperial Mathematician – whose reference Galileo continued to use, whilst failing to thank him in person or respond at all to a request for Galileo's opinion of Kepler's own earth-shaking *Astronomia Nova*. Consistently Galileo mixed perceptive insights on fundamental scientific method with arrogance, petulance and tactless behaviour! As Koestler puts it, every argument Galileo won made him a new enemy[39]. Bizarrely enough, it is contemporary Catholics like Annibale Fantoli[40] who seem anxious to make him a saint again!

5. Evidence and authority
As the historical account suggests, this is a debate as much about authority and perceived disobedience and deceit as it is about scientific evidence. More recently Pietro Redondi advanced the bizarre suggestion that the trial was a cover-up for Galileo's real offence, advocating a theory of matter which undermined the Catholic belief in transubstantiation. According to this theory, Urban almost becomes a hero who saves Galileo from a worse fate. It is not generally accepted[41] !

6. Were scientists set against theologians?
To a large extent, it was a case not so much of scientists against theologians, but of some scientists against other scientists (and philosophers, a matter of fundamental significance as we shall see) - with one group backed up by the Church.

7. Were scientists and Churchmen united against one another?
Rather like contraception at the time of its denunciation in the encyclical *Humanae Vitae,* there were plenty of views within the Church other than

the official one – but once the decision was made in 1616, discussion was closed off. As we have seen, even Bellarmine admitted that "as a hypothesis Copernicus' was superior to Ptolemy's". Whatever else one does, one cannot draw a picture of an anti-Catholic scientific propagandist supported by his fellows opposed by a united reactionary Church. The church was far more divided than that!

8. Science and the Bible
The controversy was not about the authority of the Bible, but about how to interpret it, and what it was saying.

9. Humanity's place in the Universe
One aspect the *Star Trek: Voyager* episode brings out strongly is that of the notion that the new cosmology was resisted because it undermined humanity's sense of importance. Yet, as Diogenes Allen points out, there is a fundamental misunderstanding here. In Aristotle, to be at the centre of the universe was no honour: it was to be at the lowest place. As C.S. Lewis puts it:

> 'The central position had not implied pre-eminence. On the contrary, it had implied, as Montaigne says (*Essais*, II, xiii) "the worst and deadest part of the universe", the lowest storey of the house, the point at which all the light, heat and movement descending from the nobler spheres finally died out into darkness, coldness, and passivity. The position which was locally central was dynamically marginal: the rim of being, furthest from the hub. Hence, when any excitement was shown at the theory, it might be exhilaration. The divine Cusanus (1401-64), who was an early believer (for his own, metaphysical, reasons) in earth's movement, rejoiced in 1440 to find that she also is 'a noble star' with her own light, heat, and influence (*De Docta Ignorantia*, II, xiii).[42]

10. Science vs. Religion? Did the Church reject Galileo - or did Aristotelianism?[43]
The conflict was not betwen science and religion, let alone science and Christianity, for all that this is how it is commonly misunderstood. As many - not least Harold Turner - have pointed out, modern science arose on the bed of Judaeo-Christian thought[44]. For Brooke & Cantor, it was instead "between new science and the science sanctified by previous generations ... The question for churchmen who took an interest in nature

was how far their Church was bound to protect Aristotelian principles"[45]. The proper answer was not at all, but the reason why this was not the one given is because Aristotelianism was regarded as being actually true. As Fantoli constantly insists, 'it was not at all the "compatibility" of the geocentrism of Aristotle with the biblical description of the world that led the scholastics to prefer it to the ancient theories of the motion of the earth'[46]. Rather the Bible had come to be interpreted the way it had - remember Augustine! - to make it compatible with what were regarded as the 'certain conclusions of Aristotelian philosophy'. For Thomas Aquinas, "even with the unresolved problem of the celestial motions, the natural philosophy of Aristotle was as a whole the only true philosophy and such it would always be because it was founded upon indisputable philosophical principles"[47]. When the consultors to the Holy Office rejected the motion of the Earth in 1616, it was because it was 'absurd in philosophy and formally heretical'[48]. That is, it was largely judged as heretical because it was regarded as philosophically wrong. The Church rejected Galileo because it wrongly followed the Aristotelian rejection of Galileo.

11. Conservatives and Liberals, Christianity's Positive Contribution to Science

This leads us to our next point, that rather than leap at any passing philosophy or 'certain truth', the Church should take pains to think first. This is in fact what happened in the 13th Century. One cannot make any simplistic contrast between progressive liberals and reactionary conservatives. In the 13th Century, the liberals were Aristotelians, demanding the Church alter its doctrine to fit their indisputable philosophy; in the 17th c., the Aristotelians were the conservatives, demanding that the church *not* alter its doctrine because of their philosophy. In both cases, the lesson would seem to be to think more about taking on board philosophical ideas.

The reasons in the 13th c. for resistance to Aristotelianism were genuinely theological. The Bishop of Paris condemned 13 propositions in 1270, and expanded this list to 219 in 1277. The effect on science of this Condemnation has been argued to be entirely constructive! It enabled scholars to float ideas described as self-evidently impossible by Aristotelian philosophy - the possibility of God creating other worlds and creating from nothing, of the world not existing from eternity, of God being able to move our world and create a vacuum, among others[49]. Jean Buridan and Nicholas Oresme were among those who developed notions

accordingly, even if the influence of Aristotelianism prevented them from taking ideas as far as they logically might have.

Similarly, Harold Turner has been among those wanting to reaffirm the place of John Philoponus, the 6th-c. anti-Aristotelian philosopher whose ideas largely disappeared from view as Aristotelianism became dominant[50]. His theory of impetus - grounded in his view of a God who has set his creation moving, and does not need to 'jostle it along' - was rejected by Medieval Christian Europe in favour of the notion of absolute rest, but anticipated Galileo by many centuries. Here, too the wheel comes full circle. The Aristotelian disciple who opposed him was Simplicius - on whom Galileo's Simplicio is modelled. Rather than Christianity being anti-science, its properly internally-grounded notions helped science! Galileo in his view of how both Scripture and the world should be exegeted was fully consonant with what we nowadays would call 'best practice', good 'doctrine'.

Conclusion

In a way, my title - 'The Galileo Affair: Or How NOT to engage in the Theology/Science Debate' - is a little disingenuous. It is the case that, as I have argued above, the Galileo affair has been an unfortunate point for many people to start to think about the relation of Theology to Science – because of the prevalence of widely-shared erroneous assumptions about it. Yet, at the same time, it is also true that very good, but very different, lessons can be derived from it. These may be summarised as:

(1) The Church should be very wary of blessing any particular scientific theory. It should be true to itself and its own insights. It should beware of cultural accommodation, attempts to win acceptance by endorsing the prevailing wisdom of the day. It should not trust science over fundamental theological insights – for example, about creation out of nothing, about the status of the world in relation to God. Note: this is the opposite of what many people would assume the Affair taught us!
(2) Exegeting Scripture: it has to be interpreted carefully, in terms of what the text is trying to communicate. It is not a textbook of natural science, and it is a category error to regard it as such[51].
(3) Exegeting the world: this should allow the world to reveal itself. The Church should restrict itself to its own area of expertise and not claim to lay down the law in areas of which it cannot speak authoritatively. The problem was that the Church opposed science not with a view

grounded on its faith, but rather with another (theologically dubious) scientific theory. By doing so, it ended up looking profoundly ridiculous.

(4) The model of natural science proposed by Galileo is an experimental, inductive one which seeks knowledge of the world *a posteriori* from its own concrete particulars rather than *a priori* from abstract generalities. It is in fact a model wholly consonant with proper theological method, and true of theology's own subject, God, as well[52]. The methodological axiom that the world is to be investigated *etsi deus non daretur* (as if God were not part of the picture) is also fundamental to proper scientific investigation, and an essential part of the doctrine of creation. It reflects the contingency of creation, the fact that God has created something which is other than Godself, and therefore to be investigated out of itself [53]. Galileo was entirely correct about this – as indeed he also was about the exegesis of Scripture; it might be argued that he was a better theologian than scientist[54]!

(5) Thomas Campanella wrote: "Anyone who forbids Christians to study philosophy and the sciences also forbids them to be Christians". Such a view is grounded on the notion of the unity – and therefore the non-contradiction – of truth. It breathes an atmosphere of faith. For Campanella, "any attempt to block the pursuit of science is … anti-Christian and anti-religious, for it is an attempt to silence the word of God as spoken in His creation".[55]

(6) Arguing that a scientific model is only a hypothesis is not a good technique, then or now, with relation to cosmology or to human evolution.[16]

(7) Myths about the relationship of Christianity and Science need careful analysis. History is complex, and the truth is not served by easy generalisations 'defending' either science or Christianity.

(8) Thus, whilst the thrust of this paper has been, if not to exculpate the Church, at least to show why it did what it did, ultimately one cannot avoid the fact that a grievous mistake was made with lastingly bad effects. When the Church does make an error, it should own up. As Augustine had predicted, "When they (find) that we believe, on the authority of Scripture, in things which they assuredly (know) to be false, they … laugh at our credulity with regard to its more recondite truths, such as the resurrection of the dead and eternal life." John A. McIntyre quotes this rather sadly, writing in the context of the 1999 Resolution by the Presbyterian Church in America, supporting a literal six-day interpretation of Genesis against the overwhelming

scientific consensus on the faithful report of the senses[56]. Catholics too[57] are concerned about 'the lessons of Galileo'. They – and Protestants – do well to be so concerned.

—-

[1] The human starship Voyager encounters an alien race of intelligent saurians who originated on Earth more than 65 million years ago. Leaving there in the midst of catastrophe at the end of the Cretaceous period - from a continent now destroyed (hence no remains to be dug up!) - they voyaged heroically across the Galaxy to build up their civilisation. However, they have now forgotten this, and it is heresy against 'Doctrine' to assert the forbidden 'distant origins' theory. A brilliant scientist, Gegan, dares to challenge official 'Doctrine' when he discovers DNA-markers shared with humans which prove a common evolutionary source. However, he is forced to recant when action is threatened against his human friends. Forbidden ever again to teach or engage in research, he is required to turn to metallurgy instead.
The parallels are too clear to need spelling out one by one, with the hero made even more noble than Galileo because of his altruistic reasons for recantation. The powers that be are terrified of the potential threat of his views, and act ruthlessly to suppress them. Important is the line early in the episode: 'Before all we had was a theory; now we have proof.' Whether that was so is a major part of the Galileo debate.

[2] Kingfisher Encyclopedia for Children (1991), p.277, quoted in Sampson P. 'Victim of Spin' Third Way June 98 21.5: 23.

[3] Brooke J, Cantor G. Reconstructing Nature: The Engagement of Science and Religion. Edinburgh: T & T Clark, 1998, p.106.

[4] Jn. 9; also Rev 3.17-18.

[5] Thus too Jacob Bronowski: 'What Galileo saw in the sky, and revealed to everyone who was willing to look, was that the Ptolemaic heaven simply would not work. Copernicus' powerful guess had been right, and now stood open and revealed. And like many more recent scientific results, that did not at all please the prejudice of the establishment of his day. Galileo thought that all he had to do was to show that Copernicus was right, and everybody would listen. That was his first mistake; the mistake of being naïve about people's motives which scientists make all the time' (The Ascent of Man. London: Book Club Associates, 1977, pp.204-5). Galileo's only sin therefore is a rather touching innocence about politics and human motives.
On the more complex issue of 'believing one's eyes', see the remarkable discussion in Butterfield H. Origins of Modern Science, 1300-1800. London: G. Bell and Sons, 1950, pp. 32-34ff. The evidence of Galileo's observations was also far from certain: many people could not see in his telescope the things Galileo claimed to observe in it, let alone share in his interpretation of them.

Koestler A. The Sleepwalkers. Harmondsworth: Penguin, 1964, p.374f. Fantoli A. Galileo: For Copernicanism and the Church. Notre Dame: Notre Dame Univ Press 1996, pp.117, 123.

[6] Ronan C A. Galileo. New York: G.P. Putnam's Sons 1974, quoted in Perspectives on Science and Christian Faith Sept 94 46: 179.

[7] Liben P H. 'Science Within the Limits of Truth' *Perspectives on Science and Christian Faith 92* 44:163-68.

[8] E.g. the magisterial Fantoli, Annibale. Galileo: For Copernicanism and the Church. Notre Dame: Notre Dame Univ Press 1996. *Cf* also the essays mentioned in this paper by Sampson (1988), Diogenes Allen (1989), Maatman (1994) and, especially, the up-to-date Brooke & Cantor (1998), which includes a survey of recent developments. Gingerich O. The Eye of Heaven: Ptolemy, Copernicus, Kepler. NY: American Institute of Physics 1993, and The Great Copernicus Chase and Other Adventures in Astronomical History. Cambridge: CUP 1992 include many relevant essays on the astronomical issues. Earlier, Arthur Koestler's The Sleepwalkers. Harmondsworth: Penguin, 1964 is a classic iconoclastic account of the early cosmologists. Von Weizsäcker C F. The Relevance of Science. London: Collins, 1964, is thoughtful and generally wise. Butterfield H. The Origins of Modern Science, 1300-1800. London: G. Bell and Sons, 1950, chapters 1 and 2, is excellent on the Aristotelian background. At an introductory level, Poole M. A Guide to Science and Belief. London: Lion, 1990, pp. 82-95 is generally trustworthy.

[9] From Huxley's 1860 review of Darwin's On the Origin of the Species*, in* Huxley T H. Collected Essays, 9 vols. (London: Macmillan, 1893-4), II 52f, in the volume dedicated to Darwiniana – quoted in Davis Edward B., 'Blessed are the Peacemakers: Rewriting the History of Christianity and Science', *Perspectives on Science and Christian Faith 40*(1): 47 (1988).

[10] Fantoli A. *ibid* pp.1, 9.

[11] Now a commonplace – *cf* the work of John Polkinghorne, who points out that only mathematicians can now claim to know the world! Thus too implicitly Copernicus, Fantoli, A. *ibid* p.40n38: he was insistent his work was meant for mathematicians, because only they would be able to understand him! This was twisted by Osiander.

[12] This sounds depressingly like how some people view the contemporary use of models in science. The 'solar system' model of the atom with orbiting electrons is frequently quoted.

[13] Nebelsick, Harold P. Circles of God: Theology and Science from the Greeks to Copernicus. Edinburgh: Scottish Academic Press 1985 gives detailed analysis.

[14] Koestler A. The Sleepwalkers. Harmondsworth: Penguin, 1964 is the classic (and very entertaining) account, esp. pp.333-338.

[15] Koestler A. *ibid* p.411.

[16] Gingerich O. 'The Galileo Affair' *Scientific American 247* (2): 133 Aug 1982

[17] Again, see Fantoli, A. *ibid* pp.24-8.

[18] Brooke J. & Cantor G. Reconstructing Nature: The Engagement of Science and Religion. Edinburgh: T & T Clark, 1998, p.111, using Sharratt M Galileo: Decisive Innovator. Oxford 1994. In fact, Brooke & Cantor argue that at certain points Bellarmine sounds more liberal on the interpretation of Scripture than Galileo himself. The critical point is the 'certain demonstration'.

[19] Allen D. Christian Belief in a Postmodern World. Louisville: Kentucky: Westminster/ John Knox Press, 1989, p.33.

[20] Brooke, J. and Cantor G. Reconstructing Nature: The Engagement of Science and Religion. Edinburgh: T & T Clark, 1998, pp.118-22. They persuasively argue (a) there were complaints from Spain that the Pope was being too soft on dissent (b) the Pope was under pressure to reassert his authority (c) Galileo's position on Scripture (that he could interpret it for himself) was dangerously close to the Protestant one, and defied the Tridentine view that authority was vested in both Scripture and Tradition (the general testimony of the Fathers in favour of the immobility of the Earth); in other words, that Galileo was a crypto-Protestant.

[21] De Actis cum Felice Manichaeo, I.2. As is emphasised by both Fantoli A. Galileo: For Copernicanism and the Church. Notre Dame: Notre Dame Univ. Press 1996, p.14 and Blackwell R J. Science, Religion and Authority: lessons from the Galileo Affair. Marquette, Wisconsin: Marquette University Press, 1998, pp.15-16, this is largely because Augustine does not think science is very important. What matters to him is salvation, and science is only significant if it obstructs that - as when Christians bring scandal on the faith by opining on subjects of which they know nothing.

[22] Brooke, J. and Cantor G. Reconstructing Nature: The Engagement of Science and Religion. Edinburgh: T & T Clark, 1998, p.119.

[23] Blackwell R J. Science, Religion and Authority: lessons from the Galileo Affair. Marquette, Wisconsin: Marquette University Press, 1998, p.31. Also Brooke & Cantor *ibid* p.115.

[24] Brooke & Cantor G *ibid* p.109f quote Mario Biagoli: "Urban was a sophisticated courtier, humanist, and poet, not a scholastic theologian (and that is why he appreciated Galileo so much)'. Galileo Courtier: The Practice of Science in the Culture of Absolutism. Chicago 1993, p.351.

[25] Koestler A. *ibid* pp.480-1.

[26] Quoted by Koestler A. *ibid* p.491.

[27] This explaining his aggressive behaviour of which more in the main text.

[28] Aristarchus produced a geokinetic, heliocentric cosmology that was completely eclipsed by the success of Ptolemy's. Fantoli A. Galileo: For Copernicanism and the Church. Notre Dame: Notre Dame Univ. Press 1996, p.12.

[29] Also, Bradley's observation of stellar aberration in 1728. Newton's laws of gravitation had provided the theoretical justification much earlier. Blackwell R J. Science, Religion and Authority: lessons from the Galileo Affair. Marquette,

Wisconsin: Marquette University Press, 1998, p.54.

[30] De Genesii ad Litteram, II.9 quoted in Blackwell R J. *ibid* pp.16-17, Fantoli, REF, p.14, and many other places. Blackwell, p.18, raises the important question whether certainty of this kind is actually available in science based on reason and experience.

[31] A.N. Whitehead, quoted in Sampson P. 'Victim of Spin' *Third Way 21* (5): 25 (June 1988).

[32] Koestler A. *ibid* pp.497-500.

[33] *idem, ibid* pp.389-93, a salutory reminder of the realities of the period.

[34] Firenzuola, architect of the military fortifications of Castel St Angelo. Galileo had attacked him 'without necessity (on a question of military engineering, of all things)', Koestler *ibid* p.477.

[35] Koestler A. *ibid* p.477.

[36] *idem ibid* pp. 474-5. Likewise Geymorant describes it as 'a mistaken book' (quoted in Fantoli A. *ibid* p.314, n46).

[37] Koestler A. *ibid* p.435-6f.

[38] Cf. fn.5.

[39] Koestler A. *ibid* pp.458-9.

[40] Fantoli A. *ibid* is at pains to defend Galileo from accusations. To his mind, Galileo was chiefly motivated by a desire to defend Copernicanism, which comets were being used to undermine. Galileo entered the fray reluctantly and with initial moderation; his errors about comets were nevertheless on the right lines (p.314, n46). The implication is made by the remark that Galileo was prevented from observing these comets because of a sickness which forced him to stay in bed during the entire period of their apparition (p.274) that, had he been well, he would not have made this error! The whole case in defence of Galileo seems somewhat strained. It would seem that hagiography regarding Galileo is not the preserve of atheist modernists: Brooke & Cantor *ibid* p.126.

[41] Redondi P. Galileo Heretic. Princeton, 1987. Brooke & Cantor *ibid* pp.130-2.

[42] Lewis C. S. English Literature in the Sixteenth Century. Oxford: Clarendon Press 1954, p.3. Thus too Peter Brown. Augustine of Hippo. Berkeley & Los Angeles: Univ. of California Press, 1967, p.244: "The world in which they lived was situated 'in the lowest depths of the universe', a tiny pocket of disorder benearth the harmonious stars" quoted in Allen D. Christian Belief in a Postmodern World. Louisville Ky: Westminster/John Knox Press 1989, p.28 & 219n6.

[43] The argument of Russell Maatman, 'The Galileo Incident', Perspectives on Science and Christian Faith 46: 179 (Sept 94).

[44] Turner H. The Roots of Science. Auckland: DeepSight Trust 1998. This is not the place to rehearse those arguments, nor the many contributors to this notion ranging through Pierre Duhem, Michael Foster, Stanley Jaki, Harold Nebelsick, and others.

[45] Brooke & Cantor *ibid* p.111.
[46] Fantoli A. *ibid* p.16.
[47] *idem ibid* p.19.
[48] *idem ibid* pp.37-8 n25.
[49] Maatman R. *ibid* p. 179; Turner *ibid* pp.121-4.
[50] Turner *ibid* pp.97-102; Nebelsick H. The Renaissance, The Reformation and the Rise of Science. Edinburgh: T & T Clark, 1992, pp.11-18, especially p.14.
[51] Blackwell R J. *ibid* p.33.
[52] Cf. Torrance T F. God and Rationality. Oxford: OUP, 1971, pp.29-55; Theological Science. Edinburgh: T & T Clark, 1969, pp.1-54; *idem* Reality and Scientific Theology. Edinburgh: Scottish Academic Press, 1985, pp.1-31.
[53] For a brief account of this, see my Stardust and Ashes: Science Fiction in Christian Perspective. London: SPCK, 1998, pp.33-5.
[54] Thus Owen Gingerich *ibid* argues that Galileo was bringing to the debate a fundamentally different method that paved the way to the future.
[55] Blackwell R J. *ibid* pp.20-1.
[56] McIntyre J A. 'Repeating the Catholics' Galileo Error' *Perspectives on Science and Christian Faith 52* (4): 255-9 (2000).
[57] Thus Blackwell R J. *ibid* p.54f. His particular concern is with the fundamental danger in Augustine's position: that where the evidence is not yet overwhelming, the Church is obliged to stick with a literal interpretation of Scripture. This was their downfall in the Galileo affair. 'Creation science' similarly argues that it has scientific evidence on its side, that the opposition case is not proved beyond doubt.

Intelligence or Design: Theological Reflections on the Design Argument

Nicola Hoggard-Creegan

Accidentally on purpose
They mean to tell us all was rolling blind
Till accidentally it hit on mind
In an albino monkey in a jungle
And even then it had to grope and bungle
Till Darwin came to earth upon a year
To show the evolution how to steer
They mean to tell us, though,
the Omnibus
Had no real purpose till it got to us

- Robert Frost[1]

Introduction

Evolution is often set against creation in the popular mind, in students' minds, in church and in the academy. Yet why? If we think of evolution as comprising assent to the interconnection of all life, our descent or ascent from lower forms, a non-literal interpretation of Genesis [2], and natural selection, it is really only the latter that poses an ongoing problem. And yet natural selection is and has been a huge hurdle, because so great a component of its mechanism is chance—the chance production of genetic changes that may or may not survive. The chance production of one beneficial mutation among countless less than beneficial ones, with the beneficial chosen not by any benevolent deity, but because the environment fails to eradicate them. In focussing on chance, however, we often neglect the considerable resources in our tradition that deal very adequately with descent and with non-literal interpretations of Genesis.

In this paper I first want to acknowledge briefly some of the depth of historical resources available to us if we were able to recover a form of natural theology. Then I want to trace the demise of natural theology and critique its partial recovery in the last few years in the form of Intelligent Design.

The tradition

It is not Christians but S. J. Gould and Darwin who, perhaps more than any others in recent history, see beauty and wonder and awe in the evolutionary process[3] . Yet there are forgotten and hidden theologies of nature and connection in the Christian tradition. Augustine, Julian of Norwich, Friedrich Schleiermacher and Jonathan Edwards, among others, have taught eloquently on the interconnections of all life forms, laying the basis for a theology that makes even more sense within an evolutionary paradigm.

The 18th-c. revivalist and theologian Jonathan Edwards saw "images and shadows of divine things" everywhere, and in particular he puzzled through all the natural science of his day, finding meaning in everything from Newtonian physics to the weavings of the spider web outside his house. It was the interconnections and "design" of nature that so fascinated him, the fit of an organism to its use or environment. In fact he saw them as lower forms of the love that lived in the Godhead. For example, he says

> It pleases God to observe analogy in his works, as is manifest in fact in innumerable instances and especially to establish inferior things in an analogy to superior. Thus in how many instances has he formed brutes in analogy to the nature of mankind; and plants in analogy to animals.[4]

Love in Edwards' view was Consent to Being, reaching its highest form in the internal Consent to Being in the Trinity, but also present in human love, and in other secondary forms in the harmony, order and fit of plants and animals. He could only have wondered and marvelled at the evolutionary process, whereby simple forms of complexity become embedded in higher forms, creating even more complex hierarchies of irreducible and interlocking beauty. He says:

> That consent, agreement, or union of being to being … may be called the highest and first or primary beauty that is to be found among things that exist … Yet there is another, inferior, secondary beauty, which is some image of this. And which is not peculiar to spiritual beings but is found even in inanimate things: which consists in a mutual consent and agreement of different things in form, manner, quantity and visible end or design.[5]

Edwards argues that the greater the complexity the greater the beauty. The more parts that agree with the whole the more like true love it is. And why has God arranged all things like this?

> The reason ... why God has made this kind of mutual consent and agreement of things beautiful and grateful to those intelligent beings that perceive it probably is that there is in it some image of the true, spiritual original beauty, which has been spoken of: consisting in beings' consent to being, or the union of minds or spiritual beings in a mutual propensity and affection of heart.[4]

This is certainly a grand theological affirmation of a process like evolution in which God non-coercively guides primitive life towards sentient consciousness, embeds simple life within the complex, and allows every part of the tree of life to support and embrace every other. All of this, in Edwards' theological stance, is a shadow of God's Being. Like much contemporary theology it looks at nature in proleptic terms, as anticipating a perfection and a reality now only seen dimly.

Chance

But none of this theology works if God is hidden behind and beyond the natural world**.** In the 19th c. we moved suddenly from believing in a God who was very much visible in nature to a God who is firmly absent behind the visible laws of science**.** Even poets have noted this change and have reflected upon the puzzle of design.

> My theology is a simple muddle: I cannot look at the universe as the result of blind chance, yet I can see no evidence of beneficent design, or indeed of design of any kind, in the details[4].

Darwin, then, was a turning point in theology and in the science/theology dialogue because he undermined the most important and well-understood argument from reason for the existence of God, and substituted evolution by natural selection.

What was Darwin's thesis? He argued as a result of careful observation and experiment that small changes in living organisms resulted from a combination of sexual reproduction and a struggle to survive in changed environmental conditions. These small changes over time became the

large differences we see between kinds and species today. Natural selection was, Darwin observed, much like a fixed law[6]. We are all, according to this theory, descended from simple life forms, a diverging tree of life, with multiple and interconnecting branches. Moreover, we are composites as well, of simple life forms; our cells are a microcosm of primitive units, all working together in a wonder of unity in diversity, and holding within ourselves the remnants of earlier forms — the placental sac, for example.

It is natural selection, then, that is a problem for some Christians. Theistic evolution has long been the compromise or the theological response to evolution. But it has never been enough, because so long as we are affirming the chance directedness of natural selection and other mechanisms of evolution, God remains beyond an epistemological firewall. The natural theology of yesterday seems innocent and unreachable, however profound.

Scientists and theologians have often gone along with the idea that we can learn nothing of God from nature. God's action in the world is completely hidden. This fits well to some extent with the reformed emphasis on the fallenness of our natural minds, and the Barthian predilection against all natural theology. Scientists too, have been afraid that any other position would stifle their endeavours.

How then did science and theology get to this point?

Darwin *v.* Paley

In 19th c. England there was enormous interest in what was down a microscope. This opened up the intricate design of nature in a new way. William Paley's version of the teleological argument in this context was compelling, and very influential in the life of the young Darwin. Paley's famous version went like this:

> In crossing a heath, suppose I pitched my foot against a stone, and were asked how the stone came to be there. I might possibly answer, that for any thing I knew to the contrary it has lain there for ever; nor would it, perhaps, be very easy to show the absurdity of this answer. But suppose I had found a watch upon the ground, and it should be inquired how the watch happened to be in that place. I should hardly think of the answer which I had before given, that for anything I knew the watch might have always been there. Yet why should this answer not serve for the

> watch as well as for the stone? Why is it not admissible in the second case as in the first? For this reason, and for no other, namely that when we come to inspect the watch, we perceive - what we could not discover in the stone - that is several parts are framed and put together for a purpose … there must have existed, at some time and at some place or other, an artificer or artificers who formed it for the purpose which we find it actually to answer, who comprehended its construction and designed its use.[7]

Until Darwin's time the design argument for the existence of God was an important part of theology and of the curriculum at Oxford and Cambridge. It also reflected accurately the pious intuitions of countless religious believers then and since. Darwin thought Paley's theology as beautiful as Euclid's geometry, and claimed to be completely convinced by his theories. The design argument articulated the deeply felt conviction of Christians and most other religionists through the ages. It is the sense behind Schleiermacher's insistence that

> the common element in all … diverse expressions of piety, by which these are conjointly distinguished from all other feelings, or in other words, the self-identical essence of piety, is this: the consciousness of being absolutely dependent, or which is the same thing, of being in relation with God.[8]

David Hume and others had already critiqued these arguments in philosophical terms. Hume argued that we could not make an analogy between the watchmaker and the world-maker because we had never met a world-maker. R. G. Swinburne, however, argues *contra* Hume that we make similar analogies even in science, and that an argument like Paley's is at least highly suggestive of a world-maker. Moreover, he argues that even if scientific laws can explain the order of the world, God can be posited as being behind those laws[9]. But it is important to recognize that the arguments functioned not so much as philosophical proof as descriptions of God's nature and character. They were saying both more and less than their surface meaning. Believers have always grasped their faith intuitively as well as rationally. When Paley said that the world looked as though it had been designed this was said within a theological paradigm that included humans made in the image of God and able to hear the revelation of God. Paley's critics assumed a bottom-up entirely rational approach. We *may* never have met a world-maker, but a part of piety is to assume that in one sense we have.

Was Paley's an argument "from the gaps"? I think we can answer both yes and no. Partly it is just an argument from analogy. But yet again it can also be read as saying, nothing could possibly explain this degree of order apart from a designer. And in the aftermath of Darwin, believers continued to believe in the argument from analogy though it was undermined to a considerable degree by Darwin's refutation of it as an argument from "gaps"[10].

With the refutation of Paley, though, much of the intuitive sense of God's presence and being were called into question. While he travelled the world on the *Beagle*, Darwin slowly came to the conclusion that natural forces produced the diversity of life, the changes between species, and the adaptations that seemed to make them look designed. Early on he described this force as analogous to the intentional and willed force of human breeding: "Imagine a force in nature" he says, "analogous to the hand of man in breeding domestic animals. This is natural selection."[11] Later he would switch to conceive of it more in terms of fixed law; it is as this blind impersonal force that it has entered into the popular imagination.

Reluctantly Darwin concluded:

> The argument for design in nature, as given by Paley, which formerly seemed to me so conclusive, fails, now that the law of natural selection has been discovered. We can no longer argue that, for instance, the beautiful hinge of a bivalve shell must have been made by an intelligent being like the hinge of a door by man. There seems to be no more design in the variability of organic beings and in the action of natural selection, than in the course the wind blows. Everything in nature is the result of fixed laws.[11]

We can see that Darwin himself — at least in some moods — believed the repercussions of the law he discovered to be inconsistent with a purposeful God. This is at least partially because Paley's argument was interpreted as a God-of-the-gaps argument. Nothing else could explain the intricacies of the world except a world maker. Darwin had claimed on the contrary, that natural laws explain the world. Of course if Paley's arguments are interpreted as analogies between the watch-maker and the world-maker, the analogy still stands after Darwin, but it is much weakened to the extent that natural selection is viewed as a blind and impersonal force, one later to be understood as resulting from pure

chance. God could do it this way, but if God did, that makes God rather a remote deity.

It is hard to overestimate the effect of this theory on religious understanding, and on the place of reason in belief. However, as John Brooke points out, some theologians immediately embraced Darwin[12]. They had never been enamoured of the deistic "watchmaker" God who seemed to watch over a clockwork universe. But much had come to depend on Paley's arguments. Like the God of the Sistine Chapel Paley's clockwork deity had defined God for a generation or more. And Darwin's refutation of Paley came at a time when English intellectuals held out universal education and reason rather than religion as the panacea of all society's ills. Higher criticism and Feuerbachian critiques of religion were seen as undermining Christian faith from another direction. Weber, Freud, James Fraser, and Marx were yet to come.

Peter Berger has argued that at the time of the Reformation, Scripture became the narrow channel to heaven, after all the more mystical liturgical avenues of grace had gone[13]. This made faith very vulnerable when the authority of Scripture was undermined in the Enlightenment. Similarly one might argue that for 19th-c. England, reason and Paley gave an indubitable proof of God. And thus faith was very vulnerable when Paley appeared to be overturned. It was easier then by far to deny Darwin, as the fundamentalists did, or to base religion entirely on feeling that never interacted with science. It is this same fear of reproducing a God-of-the-gaps argument and of putting all our faith eggs in the design basket that has made even evangelical Christians wary of new design arguments.

Many scientists and theologians in recent years have attempted to do theology facing the undeniable challenge of the fossil record — and increasingly biochemical and other evidence — but also the challenge of evolution by chance. For some, other words have entered into the vocabulary. Arthur Peacocke, for example, talks of "emergence", but what exactly does that mean, except that chance and time and the other forces of NS eventually produce the order and complexity of ourselves[14]? It also means that orders of complexity not predictable by lower levels of organisation emerge by natural processes. They are explicable, but not predictable**.**

After Darwin we can reflect only on a process that seems to leave God

firmly hidden behind the scenes, a process that is described resolutely as being chance rather than intelligence. For some, this hidden God is acceptable but it is ultimately unsatisfactory. Isaiah may say, "truly you are a God who hides yourself", but never in human history has that hiding been so complete.

Postmodernity

But in the late 20th c. the design argument has been reinvented, this time by looking closely at the biochemical processes of nature, and re-emphasising some of the complicated interlocking complexity in the biochemistry of the cell.

Perhaps the time is ripe to consider complicated complexity because our worldview is now changed. Postmodernity is characterised by flux from the level of galaxy to that of quark, or evolution. The billiard ball clock-work universe of the 19th century is gone — Michelangelo's planet mover is no longer. We are more likely to take wholes and subjectivity into consideration and we are more likely to admit to paradox in the structure of reality.

If God is very intimately associated with nature we might expect boundaries over which we cannot go, rather than gaps. Heisenberg's Uncertainty Principle is such a boundary. The dual nature of light is another. Godel's theory is another in terms of what an algorithmic approach can give.

There have always been paradoxes in mathematics and logic that suggest this boundary — in transfinite numbers and the foundations of logic, for example. The Planck era at the moment is an epistemological boundary and may always remain so[15]. But what of the mystery of life? There is a growing sense that powerful though Darwin's theories may be they do not get to the heart of this mystery. They do not explain satisfactorily the extraordinary tree of life, and the emergence of sentience and intelligence.

We have also reached an impasse of sorts. Although biological scientists and a few theologians live in a world where they are content to believe that God does not exist or that God is hidden, countless numbers of believers are not. And in spite of 150 years of evolution theory a huge majority of people still do not accept it.

Intelligent Design

In this context Intelligent Design theory has emerged in the last few years. Some ID theorists are evolutionists and some are not. But they all postulate that God must intervene directly and unnaturally at various stages of the evolutionary or life-giving process. Even more than Paley, ID theorists claim to have found levels of complexity so great and so interlocking, in the biochemistry of living organisms, that neo-Darwinian mechanisms simply can't account for their emergence. Moreover, were we to discover complexity of this order elsewhere, they claim, we would assume an intelligence behind it.

Main ID writers include William Dembski, Phillip Johnson, and Michael Behe[16]. Dembski and Behe and many others involved are scientists; Johnson is a lawyer. And again, I want to say up front, that I agree and disagree with ID. And I hope that will be clear. I think it is changing our perception of God in nature. At the same time Behe and Dembski and others are overdefining design. The claims they make are too strong, and increasingly too political. And in particular, I think they have problems in the area of divine agency.

ID sees natural laws as fairly neutral and secular, and thus ID theorists agree that natural selection, genetic drift, and other mechanisms of neo-Darwinian evolution take place but are not as important as Darwinians think. The ID people have a high view of God's ability to intervene, and the need for such intervention in evolution. They are convinced that this intervention is visible, in fact so visible that it can be proved conclusively and compellingly.

The first form of ID is irreducible complexity (IC), the topic of Behe's book *Darwin's Black Box*. It refers to those biological or biochemical processes that depend to such a degree upon all the parts being in place in order to work at all, so that there appears to be no way they could get there by the slow evolutionary history whereby one protein or structure is evolved at a time. Behe's famous metaphor for IC is the mousetrap. A mousetrap isn't any use, he argues, with any one its parts - a board, a spring, a hammer, a catch or a hold-down bar - or with only any two or three of these. It needs all five, and needs them in place to work at all. A knife, by contrast, can easily be imagined to have evolved by slow changes and accretions from a blunt cudgel to today's high-tech cutting implement.

One of Behe's examples is the clotting of blood, which requires a whole series of proteins cascading together to work. Darwin himself said that were any organism found that could not be assembled bit by bit his theory would fail. Richard Dawkins, who denies that Behe has proved anything, concurs with Darwin. If a true case of IC were to be found, he says, he would cease to be a Darwinian.

Besides Behe, the other major figure is William Dembski**,** winner of the *Christianity Today* Book Award in 1999 for his book 'Intelligent Design'. He has PhDs in philosophy and mathematics and wants to prove conclusively, or at least scientifically, that the natural world, and in particular the evolutionary process, is the result of an intelligence at work.

Intelligence leaves a trace, he claims, and this trace can be detected by signs that are characterised by contingency, complexity, and specification. That is they must not be the inevitable result of their means of transmission, they must be complex enough not to have arrived by accident and they reveal some order that can be specified independently of the transmission itself. The first three prime numbers would not have enough complexity. The first twenty would. Alternating ones and zeros would not have enough complexity even though it is a specified run. Fifty random numbers would be complex but not specified. His theory sees IC as a special case of SC, and he uses probability theory to determine when specification is powerful enough to render the phenomenon unlikely[17].

Theological reflections on ID

Does ID bring God back into the evolutionary picture? Not so easily. Even without the scientific critique, we still ask: Where does God do this placing together of all the slowly evolving bits? And are Behe and others like him opposing evolution or just neo-Darwinian evolution?

If there is a guiding hand of God it must go very deep, to the inner ubiquitous complexities of the cell, and this hand must be present at every level of organisation. It becomes hard to imagine where the natural processes would end and where God's would start. If God is intimately designing natural processes, how there can be any measure of freedom? How does God guide in a non-coercive manner?

There are also theological problems with an ID model that postulates natural laws overlaid by an intervening God. The special miraculous nature of the Spirit's intervention is emphasised over God the Spirit's continuing upholding and preservation of the world. Theologians have

also argued that the strong emphasis on design does not do justice to the freedom consciousness exhibits within the parameters of design. For example, John Haught says:

> What I object to is the narrowness of any theological approach that seeks to defend the idea of God, or to understand God's relationship to an evolving universe, and especially the evolution of life, by focusing exclusively on "design".[18]

The main thrust of theological objections to ID, however, comes from those Christians who suspect that these new design arguments are merely forms of God-of-the-gaps arguments and are therefore dangerous and very vulnerable. They prefer to live with a God who creates by chance, who is safe from the fray of the evolutionary debate, and they do not want any more God-of-the-gaps arguments. What happens, they ask, when scientists find ways that IC could be explained naturally?

Scientific responses to IC and ID

That is exactly what has happened. Scientists have now come up with plausible mechanisms by which supposedly IC processes might have evolved by Darwinian means. Critics of IC have shown that proteins can be "borrowed" or "stolen" from other sources and modified for use in the blood clotting system for example. Low-pressure animals would need only a sticky substance in their blood to stop the bleeding. By the time the animal has evolved to a higher form the full blown escalating system of blood clotting has evolved also.

Nor does IC and SC make sense of designs that seem to be only near perfect, or of bits of junk chromosome that appear to be passed down the evolutionary tree. Others like Prigogine and Kauffman speak of the inherent self-organising ability of organic chemicals. Most importantly scientists claim that postulating IC or SC will stifle their research.

Chance vs design: assessment of ID

Where does this get us? IC is not quite irreducible — but to my mind its ubiquity and complexity is still extraordinary. ID theory has brought this complexity into focus, and has given us perhaps a different view of the natural world than we might have imagined previously. For Behe, though, this complexity must be explained by an external God. Behe and Richard Dawkins both live in a world where God is seen as an outside intruder. Behe wants to argue for the intruder, Dawkins against.

We all look out onto a world that would be very different but for the intruding impact of human intelligence. It is natural to suppose that God's intelligence at work should be equally irresistible, and that absence of any traces of intelligence would count against the existence of a deity.

But this is to confuse the nature of divine and human agency. Divine agency must by its nature be ubiquitous, even if it is sometimes extraordinary and human-like. And divine agency is not bound by time, but is always calling the future into the present, or the present into the future.

There is something wrong with a view of God as an intruder. Christian theology has always postulated that the trinitarian God is both immanent and transcendent, even if the immanence is rarely emphasised outside the mystical traditions of the church. Increasingly we have studied nature as though it is separate from God, and as though its laws are autonomous. If God is both immanent and transcendent, though, I think we should expect that natural laws will be a part of the character of God as are moral laws and mathematical theories.

In terms of IC this may mean complexity has emerged by so called natural processes but that these means are not quite so random as they have been supposed to be. And indeed there is evidence that newer non Darwinian models of evolution are emerging. One Israeli scientist, for example, said recently in *Physica A* that "My basic assumption is that the observed creativity in nature is not an illusion but part of an objective reality, and as such should be included in our scientific description of reality."[19]

Nature shows signs both of extraordinary intelligence and signs of trial and error—evidence of design and natural selection. And yet that is what we might expect from a God who gives a measure of integrity and freedom to all life forms while holding all life within God's teleological care.

We can make parallels, I think, with Scripture which reveals itself both to be inspired but also to bear the marks of the culture in which it is written, and to be vulnerable to the errors of scribes and other circumstances. There are also more mundane parallels with the mathematics of infinity. Mathematical facts about transfinite numbers abound, but at other places we run into paradox. Similarly with God. We can't say how God does the IC, but we can recognise hints of intelligence, while also

acknowledging them as the result of a natural process. Natural laws must be understood as a reflection of God's nature much as moral laws are. The nature of divine agency will therefore be very different from ours. God is not an intruder. God is everywhere.

It is also possible to see this order within the context of extraordinary patterns in the mathematical world. Numbers and patterns like the square root of negative one, and e and Fibonacci numbers keep appearing in natural and mathematical systems in a way that speaks of intelligence at work[20]. Many mathematicians talk of discovering rather than creating mathematics and the kind of order we see is reminiscent of that which would cause us to suspect intelligence from a SETI perspective. Mathematics, physics, aesthetics and beauty all point to an overarching intelligence at work, one we can recognise but never prove as a gap, because it is omnipresent. The interconnections and the evolutionary progression point to a great and non-coercive mind at work.

On the one hand, then, I believe ID theory is wrong to make the strong irrefutable claims it does about IC and SC. On the other hand ID theorists are right to point us again to the natural world and the way in which at every level it exhibits signs by analogy of intelligence at work.

ID does point beyond the natural and mechanistic to give us a glimpse of God in nature. This complexity will be always be reduced by some to step by step processes, and all transcendence and intelligence will be denied. Others will rediscover a vitalism within nature itself. But as Christians we can say that we see the hand of the trinitarian God at work, and this complexity may be accounted for at one level but never reduced to that level.

Chance and non-Darwinian evolution

In spite of irreducible complexity, though, chance remains the difficulty. There are hints, however, that the process may not be as random as was once thought. Ironically, the efforts of scientists to rescue IC for the Darwinian system may in turn reveal something new. Most of the accounts of how IC can be reconciled to a Darwinian model hide an enormous amount of teleological language. This is what Neil Broom, for example, has pointed out in *How Blind is the Watchmaker*[21]. We are all familiar with this language in terms of "Nature does this" or does that. "Nature designed this for that purpose." Nature language has long entered into popular accounts of how things come to be the way they are.

But this kind of language also enters into scientific accounts.

There is increasing evidence for some form of non-Darwinian evolution, evolution that is more dynamically related to the environment[22]. A lot of scientific language suggests a teleological process. These are some quotes, for example, from Kenneth Miller's excellent book, *Finding Darwin's God,* a critique of all antievolutionary and design theory arguments, anything that disagrees with Darwinian mechanisms being the only ones that run evolution.

> In 1997 John M. Logsdon and Ford Doolittle reviewed in detail how these same mechanisms could have produced in strictly Darwinian fashion the remarkable anti-freeze proteins of Antarctic fish. The novelty of this study is that it contains examples of how evolution *could recruit* introns, the noncoding regions found in the middle of many genes, to produce dramatic changes in the characteristics of proteins.[23]
>
> Evolution *assembles* complex biochemical machines from smaller working assemblies that are adapted to fit novel functions.[24]
>
> The powerful opportunistic pressures of natural selection *progressively recruited* one gene duplication after another, gradually fashioning a system in which high efficiencies of controlled blood clotting made the modern vertebrate circulatory system possible.[25]

Notice here that evolution very cleverly 'recruits' and 'assembles'. This opens up a huge cavern in terms of interpretation and mechanism. What exactly is happening when evolution 'recruits'? But there are numerous other hints that biological challenges to the blind chance model of evolution are surfacing as non-Darwinian evolution or adaptive evolution[26].

We are left with the suggestion of a changed understanding of evolution. But an evolution that is not much like the blind force of which Darwin spoke. It is more similar to the force "almost analogous to the hand of man" in animal and plant husbandry.

Conclusion

How can we begin to reconcile all this with the creator/immanent God of the Scriptures? God must be immanent, but separate, intimately and teleologically concerned with creation yet not coercively present. The intruder God envisaged by some intelligent design advocates is not the Christian God; nor is the radically hidden God of some Darwinian models.

Some solution to this problem is found in rediscovering the trinitarian nature of the creating and redeeming God, and the eschatological *telos* that draws all levels of existence toward God's intended future. The need for immanence and transcendence is met in a God who brings the universe into being, but is intimately present in the Spirit, within the laws of nature, which are characterised by all pervading logos or wisdom.

But there will always be a wholeness and integrity to God that we can never fathom, but will be experienced by us as paradox or mystery, just as there is a wholeness and integrity to ourselves and our consciousness that can never be done justice within any reductionistic science. Complexity in the evolutionary process and the cosmological evolution suggest divinity at work because they bear the marks of conscious intelligence as we know it, not because they cannot be reduced to step by step evolutionary processes.

Atheistic science will always be able to "see" nature in terms of reductionistic mechanisms and nothing further. Neopagans will encounter the force of nature in terms of a new vitalism. But Christians can take both scientific insight and the evidence of intelligence and beauty in nature, and make sense of these within the trinitarian God-story revealed in Scripture. We are called back from our contemplation of the universe to discover that the Word has always hinted at a cosmic Christ and a Spirit imbuing God.

. —-

Q: I am Don Nield. I have written an article for the New Zealand journal of Christian thought & practice 'Stimulus', and there's a high probability that this article will appear in the May issue of the journal [it did - ed.]. This is on essentially the same topic as Nicola has just been talking about. I think we agree on the essential issues.

Q: I wonder whether some of our difficulties we have with our understanding of creation actually relate to some of the models we use. Often the model we use for trying to understand creation is of God playing with his train set and sticking a finger in and changing here or there or not. Is a more natural model of the creation existing within the womb of God, in a sense - where the creation grows on its own and yet is constantly affected by the very being of God? Might this be more helpful for us?

Creegan: Yes I would agree with that. I think that's the model for example that Denis Edwards presents.

Q: I was intrigued with your definition of irreducible complexity. In the Darwinian theory, life happened by chance. There is an irreducible complexity in the fact that we have the proteins of the cell, which can be created, say, by accident in the primeval soup which we talk about. But how did the DNA get into that cell to tell it at what stage to multiply into a skin, eyes, ears, or whatever the first animal of being was, alive on Earth?

Creegan: You're asking me? That's not really a question for me to answer. The origin of life itself is the biggest of the problems associated with evolution. Dembski would certainly put that under the heading of what he calls 'specified complexity' - the odds against its happening just by chance are so great that it then becomes a question of 'what else happened?'

Dr Carolyn King: I'd like to congratulate you on your very balanced presentation; but having said that I'd also like to emphasise a point of disagreement. You're a theologian venturing into science; I'm a scientist venturing into theology. I'd like to think we could meet in the middle and collaborate somehow. From my point of view I'd like to draw a clearer distinction than you did on the difference between chance and natural selection. I'm not saying all of evolution is entirely due to natural selection, because there are other processes, that's quite true; but it is generally the most powerful of the processes that are at work, largely because it's the most widespread.

You emphasised the role of chance; but in actual fact, natural selection is comprised of two processes: the production of the mutations (which is by chance), but then the filtering of those mutations by natural selection. Of the two, mutations are vastly rarer than the processes of natural selection operating on the variants produced by sexual reproduction and recombination in every generation, and environmental variation, and any number of other processes as well.

So, although no biologist would deny the role of chance, to us the lawful process of natural selection is itself rather more important.

You quoted Peacocke's point about the interaction between law and chance; that describes it exactly. Therefore I don't see there's any need to emphasise the problem of chance, which is such a problem for theologians, to quite the extent that is often done. Evolution is not anything like such a chancy process as that view would make it appear.

Creegan: Thank you; we'll have to talk more about this. I agree with you, obviously. But it's not immediately obvious, at least to theologians, that the lawful part of it makes it any easier. But I don't think there's time to discuss that here.

King: What it boils down to is what you're comparing with what. If you're comparing it with an ideal, that's not a valid argument from a biological point of view. What natural selection does is to compare the variations that it has got, between those that are available, and not between those that are available and an ideal. The easiest way to remember that is: two guys are running away from a bear or a lion, and one says to the other "it's no good, I'll never run as fast as John Walker"; the other will say "neither can I, but I don't mind, I only have to run faster than you" [laughter].

Finlay: I must say that Nicola has an honours degree in mathematics.

There is a confusion about chance which atheists like Richard Dawkins continually abuse. On the one hand, chance is a scientific concept and we cannot doubt there are probabilistic elements in the constitution of the universe; and we can only say that God, the father of our Lord Jesus Christ, is the Lord of that probabilistic aspect of nature. On the other hand, there's the philosophical sense of 'chance' as something radically uncaused. Whereas people like Dawkins don't distingish between these two, I think as Christians we should see God as the Lord of chance as a scientific concept while at the same time totally rejecting the atheistic sense of chance as being something radically uncaused, because surely we believe in the God who continually supervenes over his creation.

---

[1] from the poem Accidentally on Purpose by Robert Frost, discussed by Walhout MP *in* 'A Poet Reads Darwin' *Books and Culture* Jan/Feb 1999 Vol. 5 no 1 p.28.

[2] For a history of non-literal interpretations of Genesis see Lewis JP 'The Days of Creation: An Historical Survey of Interpretation' *Journal of the Evangelical Theological Society 32* (4) 433-455 (Dec 1989).
[3] Gould SJ "I Have Landed" in *Natural History 100 Years 12/00-1/01* 2001. p. 46 says "I would nominate as most worthy of pure awe the continuity of the tree of earthly life for 3.5 billion years, without a single microsecond of disruption." And Darwin himself said "There is a grandeur in this view of life; with its several powers having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most wonderful and most beautiful have been, and are being evolved." *The Origin of the Species* 6th edn. London: Oxford University Press 1956 p.560.
[4] Edwards J *The Nature of True Virtue* in *Jonathan Edwards: The Ethical Writings,* edited by Ramsey P. volume 8 of *The Works of Jonathan Edwards* ed. Smith JE New Haven: Yale University Press 1989 p.564.
[5] *Ibid.* p.561.
[6] See Darwin C Religious Life. Extracted from his *The Autobiography of Charles Darwin 1809-1882* with original omissions restored. Edited with appendix and notes by his grand-daughter Nora Barlow 1958. Available on the web at http://www.update.uu.se/~fbendz/library/cd_relig.htm.
[7] Paley W *Natural Theology* 1802 chapter 1.
[8] Schleiermacher FDE *The Christian Faith* Mackintosh HR & Stewart SJ (eds) Fortress 1976, §4.
[9] See a discussion of this in Brody BA (ed.) *Readings in the Philosophy of Religion: An Analytic Approach* Englewood Cliffs NJ: Prentice-Hall 1974 p.137f.
[10] A part of Darwin's insight, however, must be credited to theology and the concept of design that so enthralled him during his theological training. Darwin had an extraordinary preparation for his seminal voyage — a long training in careful observation of all manner of insects and geological formations, and the concept of design from Paley.
[11] Darwin C *Religious Life*
[12] Brooke JH *Science and Religion: Some Historical Perspectives* Cambridge: Cambridge University Press. 1991 p.41.
[13] Berger PL *The Sacred Canopy: Elements of a Sociological Theory of Religion* Garden City, NY: Doubleday 1969 p.11.
[14] Peacocke A. *Theology for a Scientific Age* (enlarged edn) London: St. Albans 1993 p.62.
[15] This era is the first 10^{-42} second after the Big Bang, when none of the known laws of physics obtained.
[16] See for example, Behe MJ. *Darwin's Black Box: The biochemical challenge to evolution*. New York, NY: Simon & Schuster 1996; Dembski M. *Intelligent Design. Downers Grove, IL:* IVP; and Johnson PE. *Darwin on Trial*. 2nd ed. Downers Grove IL: IVP. 1993 & *Defending Darwinism by Opening Minds*. Downers Grove, IL: IVP 1997.

[17] Dembski is an increasingly controversial figure; he is a tenured professor at Baylor University but he has just been fired from his position as director of the Polanyi Centre at Baylor. He is connected to the Discovery Institute that is attempting to fund SC research and is attempting to get SC and design into schools. The reaction to Dembski has been perhaps especially extreme because the claims he makes are so strong. My assessment of Dembski is that he is more right than wrong, but his polemical style and strong claims and somewhat over-analytical approach puts people off and makes him very vulnerable. He is now routinely associated with creationism. However he is an evolutionist and the people with whom he discourses include philosophers at major institutions — a very different world of discourse from those of 'creation science'. Even Houston Smith, the great comparative religionist, recently upbraided the scholarly world for ridiculing ID.

[18] Haught JF *God After Darwin: A theology of Evolution* Boulder, CO: Westview Press, 2000.

[19] Eshel B-J 'Bacterial Wisdom' *Physica A 248* 57-76 (1998).

[20] See *e.g.* Huntley HE *The Divine Proportion: A Study in Mathematical Beauty* New York: Dover 1970, and Rees M *Just Six Numbers: The Deep Forces that Shape the Universe* London: Phoenix 2000.

[21] Broom ND *How Blind is the Watchmaker?* Aldershot: Ashgate 1998.

[22] For further examples of non-Darwinian evolution see Depew DJ & Weber BH *Darwinism Evolving: System Dynamics and Genealogy of Natural Selection* Boston: MIT Press 1995; Eldredge N *Reinventing Darwinism: The Great Debate at the High Table of Evolutionary Theory* John Wiley & Sons 1995; and Hull DL *Science as a Process: An Evolutionary Account of the Social and Conceptual Development of Science* University of Chicago Press 1990.

[23] Miller N *Finding Darwin's God: A Scientist's Search for Common Ground Between God and Evolution* New York: Harper Collins 1999 p.149.

[24] *Ibid.* p.150

[25] *Ibid.* p.157

[26] These are excerpts, for example, from a recently published paper (ref. 19 p.57-76): "Although far from being generally accepted, a picture of problem-solving bacteria capable of adapting their genome to problems posed by the environment is emerging. This is a picture radically different from the contemporary picture of lifeless, passive DNA used as a memory storage for protein production." . . . "My basic assumption is that the observed creativity in nature is not an illusion but part of an objective reality, and as such should be included in our scientific description of reality."

The Contemporary World of Bioethics: The Demanding Interface Between Science and Christianity

D. Gareth Jones

Presented abbreviated as a lecture to the symposium 'Science and Christianity' to honour Harold Turner and John Morton, Auckland 01-4-21.

Introduction

Just before Christmas an article appeared in *The Australian* with the provocative title of 'Clones versus Christ: The new battle between science and church'. In this the Religious Affairs Editor, James Murray, wrote: "The cloning of a perfect human being is now easier to believe than a perfect baby in a manager in Bethlehem. The virginal conception of Jesus pales into insignificance in the face of *in-vitro* fertilisation interventions." However erroneous that statement may be scientifically, Murray uses it to launch a reasonably accurate assessment of the churches' response to the biomedical technologies, which he describes as "usually prohibitive, negative and justified by an appeal to an unchanging morality derived from a divine authority few people still recognise."

While I would not use exactly these words, Murray is correct in homing in on the negativity of many in the Christian community when confronted by the prospects opened up by developments within the broad field of biomedicine. Many are fearful of what science is doing to us as human beings, and of where it may be taking us. Such a response is highly significant for the relationship between science and Christianity today, since the world of biomedical manipulation is no longer a scene from science fiction or a timid glimpse into a possible future. It represents an uneasy tension - between powerful technologies that appear to be controlled & directed by human beings, and God's world that is frequently viewed as separate from modern technology, and even threatened by it.

Consequently, the relationship between science and Christianity is fraught with problems throughout the whole realm of biomedicine. For many Christians, including theologians, the only appropriate response is one of

vigorous opposition to much within the contemporary biomedical enterprise, and even to the enterprise itself. So strong is the opposition in some quarters[1] that Christians who are prepared to espouse the advances of science at the beginning of human life are regarded with the utmost suspicion. Unfortunately, a warfare motif is not an inappropriate one.

Christian opposition to biomedical developments

In the mid-1980s, theologian Thomas Torrance[2] expressed his profound disquiet at what he thought was taking place in the artificial reproductive technologies. He wrote:

The application of modern scientific technology to human reproduction has thrown up an issue of the utmost gravity. . . . What is at stake is nothing less than the future of the human race, but what is also at stake is the integrity of the scientific and moral conscience. In experimentation with human foetuses, in the manipulation of human embryos, in test-tube fertilisation, in the cross-fertilisation of human with non-human species, in surrogate motherhood, medical science has brought us to an ultimate boundary beyond which a civilised and God-fearing society committed to the sanctity of marriage and the structure of the human family, *may not go.*

The fundamental principle for Torrance[2] is that no human being should be treated as a means to an end, including human embryos, no matter how early in development. As a result, he regarded it as morally indefensible to bestow upon the alleviation of infertility a higher right than that accorded the gamete or embryo. In his view, the act of choosing between embryos, with the subsequent destruction of some embryos, is an utterly abhorrent form of exploitation, since it represents exploitation of the weakest of all human beings. Basic to these responses are Torrance's Christian convictions, namely, humans have been made in the image of God, the incarnation of Jesus has given to the human embryo a sacred inviolable status, the embryo is a person, and human beings (at any stage of their existence) may never be treated as a means to an end[3].

At a far more general level, another theologian, Oliver O'Donovan[4], has condemned many facets of modern medicine. For instance, he considers that medical technology has betrayed its heritage of humility and has been transformed into a means of manipulating human nature:

Medical technique has been shaped and developed with the intention of fulfilling aspirations for freedom, freedom in this case from the

necessities imposed upon us by our bodily nature. ... The old conception of medicine as a collaborative enterprise, in which doctor and patient each have freedoms and responsibilities, can no longer be sustained ... Christians should ... acknowledge that there are limits to the appropriateness of our 'making'. These limits will not be taught us by compassion, but only by the understanding of what God has made, and by a discovery that it is complete, whole and satisfying ... Technique must have its sabbath rest.

It is against this background that O'Donovan[4] writes about the ambiguous humanity of babies brought into existence by artificial reproduction. He is concerned that when we start making human beings we necessarily stop loving them, since something that is made rather than begotten becomes something we have at our disposal, not someone with whom we can engage in brotherly or sisterly fellowship. Such concerns stem from a fear that biologists are engaging in self-mastery and self-transcendence, and that in creating beings in the laboratory they are usurping creatorial functions that belong rightfully to God. In acting thus, they are making some human beings the creatures of other human beings, thereby denying to some the wealth and profundity of human relationships; for O'Donovan this is of major theological significance since it is a false claim of lordship.

My third illustration is provided by some of the concerns of medical ethicist C Ben Mitchell. In response to the HGP (Human Genome Project) announcement in June 2000, Mitchell[5] wrote:

The bad news is that the science is being done in the context of what amounts to a moral dark age. Despite the status of 21st-century science, our moral sensitivities are at a very low ebb . . . we are dominated by technological giants and ethical pygmies . . . Unless public scrutiny is radically enhanced and unless ethical vigilance is rigorously applied, this moment will be remembered in history as a very inglorious day of infamy.

The bleak language employed here prompts us to ask what ethical perspective would be required to transform the context within which this exciting work is being conducted. This quotation gives the impression that a Christian perspective is an entirely negative one about the HGP, let alone cloning. Is this a fair assessment, or does it reflect a theological perspective dominated by a particular viewpoint of the human embryo?

Has a broader Christian framework been lost?

These questions apply to each of the perspectives I have alluded to. It may be that the essence of current biomedicine is implacably opposed to Christian essentials, and if this is so, then a warfare metaphor is apt. Many Christian commentators would agree that this is the case, although this is far from generally accepted by theologians let alone biologists within the Christian community. In order to delve further into this state-of-affairs I shall employ a single example, that of human reproductive cloning, that is, the cloning of human individuals. I am using this particular form of cloning because it illustrates in an extreme form what I see as the essence of the science-Christian debate in the biomedical domain.

Opposition to cloning - the general debate

Those who are opposed to the very idea of cloning are in the majority, and so it takes little prescience to adopt this position. Opposition to cloning is to some extent tied up with opposition to scientific developments and possibly even to the scientific enterprise itself.

Cloning is seen by some as a metaphor and a mirror, allowing us to look at ourselves and our values, and so decide what is important to us and why. It also reflects the place of science in our world. Is science a threat or a promise, and are scientists sages or villains?

For many commentators, cloning has become a metaphor for unbridled science. Since the 1970s, biological science has been viewed with scepticism by the public at large. It has taken on a fearful facade, with scientists being viewed as intrinsically untrustworthy. Gina Kolata in her book *Clone: The Road to Dolly, and the Path Ahead* has described this transition well, with scientists being increasingly viewed as beings driven by curiosity, and more by a perverse glee in manipulating life than by moral qualms about what is proper and appropriate[6]. It is this enduring distrust of science and scientists that has made cloning a subject of notoriety and poor taste. All sections of society, including the Christian community, are affected.

The cloning of a human being has become a symbol of the unforgivable scientific sin[7]. Hence, serious discussion of cloning - any form of cloning - is mired in this symbol of laboratory maleficence. The public has been alerted to this Faustian bargain, and it will not lightly forget the price science is exacting for its ill-gotten gains. Cloning has become a

metaphor for the temptation of scientists to play God, a metaphor which however misused and twisted has extraordinary power to frighten and appal. For many, it is the epitome of biologists knowing sin, just as physicists had known sin with the development of the atom bomb.

Leon Kass[8] has spoken eloquently against cloning, in line with his strident opposition to many of the developments in the reproductive area. In his essay 'The Wisdom of Repugnance' he retraces steps already taken in his earlier essays on making babies. The nature of his critique is summed up with his description of Dolly as the work not of nature, nor of nature's God, but of man.

For Kass[8] cloning is a pollution and perversion of begetting; it is despotic, and a blatant violation of the parent-child relationship. It dehumanizes procreation, by degrading it through commodification. The emotional reaction shines through in his writings, but one gets the feeling that what he is describing is cloning on a mass scale and for the worst of motives. This cannot be readily dismissed, since this worst of all worlds scenario is feasible. But is it inevitable?

As one scans the general literature criticizing cloning, it soon becomes evident that the arguments revolve around a limited number of themes, which while expressed in a variety of ways reflect common concerns. Cloning is regarded as a threat to human dignity, on the ground that an individual should never be thought of only as a means, but always as an end, *i.e*. humans should never be treated as objects. If they are, cloning will lead inevitably to the instrumentalization of human beings. Closely tied in with this threat is an undermining of an individual's uniqueness & unpredictability, and to a loss of individuality & autonomy. Included within this concern is that humans have a right to ignorance, to an open future, and to a quality of separateness. This is seen as necessary for the spontaneous, free, and authentic construction of a life and self.
Many of those writing from a Christian perspective find the gist of these criticisms of cloning highly congenial. Hence, arguments against cloning advanced by Christian writers tend to be an extension of those I have already alluded to.

Theological arguments against cloning

Arguments by theologians [9-13] centre on cloning being regarded as:

- overstepping the limits of human dominion
- violating human dignity
- reducing its products to a sub-personal status
- making children as opposed to begetting them
- subverting the uniqueness of human beings
- fostering a reductionistic view of human nature
- militating against the uncontrollability of biological processes.

This is an intriguing mix of theological and pragmatic arguments, which have a great deal in common with general arguments against cloning that claim no theological grounding. Meilaender[13] for instance starts with the creation story in Genesis, where he recognizes a connection between the differentiation of the sexes and the begetting of a child. For him maintaining the connection between procreation and the sexual relationship of a man and woman is essential both for that relationship and for any offspring. The male-female relationship is seen by him as foundational, since once this is lost the sexual act and any resulting children become the province of individuals and not of a couple. Hence he sympathizes with those who see cloning as narcissistic and as nothing more than a replication of one's own self. To him the whole process is demeaning, reflecting one person's own desires.

This points to a fundamental issue, namely, the relationship between cloning and the artificial reproductive technologies in general. Part of Meilander's rejection of cloning is also a rejection of all artificial reproductive technologies. Any technical intrusion into human procreation can be seen as threatening the personal relationship between male and female, whether this is AIH, IVF (or one of its many offshoots) or cloning. There is no doubt that each of these procedures can be misused or even abused, but this by itself is not an argument against their very existence. Of course, if it is asserted as a basic theological tenet that any artificial intrusion into human procreation is sub-Christian, conflict immediately arises between what is acceptable theologically and what can be accomplished scientifically. This, in turn, places the biomedical enterprise at loggerheads with theological imperatives, so that anyone espousing scientific exploration of human reproductive and early embryonic development will be viewed as espousing the biomedical enterprise to the detriment of basic Christian values. This presupposes that these theological arguments accurately reflect biblical principles, a highly debatable presupposition[14,15].

Meilaender[13] also draws a distinction between begetting and making. While 'begetting' results in someone like us, 'making' results in someone unlike us. Begetting expresses equal dignity since we are not at each other's disposal, whereas making loses this sense of equality. These criticisms of course apply to most of the artificial reproductive technologies, although cloning is viewed by Meilaender as a new and decisive turn down this road. From this perspective, cloning is even more a form of production, "far less a surrender to the mystery of the genetic lottery . . . far more an understanding of the child as a product of human will."

But will the resulting children actually be viewed as a product rather than a gift? This is a pragmatic argument, and empirical evidence based on what is known about IVF and DI (donor insemination) children provides no evidence to support this contention[16,17,18]. In other words, the presence of an artificial element in reproduction does not lead inevitably to a downgrading of the subsequent status of these children or adults. This should come as no surprise, since the resulting individuals give every impression of being ordinary individuals. The things that matter are attitudes and motives, treating others as equals, as beings of dignity, regardless of their method of fertilization.

Use of the term 'genetic lottery' is instructive, since it points to the unknown nature and the uncontrollability of biological processes. In theological terms, is the lottery element of genetic inheritance integral to God's plan for human reproduction?

The randomness of genetic inheritance is basic to sexual reproduction with the redistribution of characteristics that goes to make up the emerging individual. Consequently, any process which had major repercussions for this redistribution would be foolhardy, since it would take us well beyond human abilities - now and perhaps at any time in the future. But does this also mean that the occasional deviation would be catastrophic? The answer appears to be 'no' since identical twins are deviations, and everyone lives with these in a remarkably straightforward fashion. Cloning on a vast scale would have detrimental consequences genetically, but cloning on a very limited scale would probably not lead to these.

When the genetic lottery goes seriously wrong, resulting in distressing diseases, we attempt to rectify what has gone wrong. Conventionally, this is done indirectly, by understanding the problem and manipulating the results of the genetic errors. But is there any difference *in principle*

between this and directly influencing genetic combinations? The issue is not the detail, but the extent to which we are or are not prepared to accept what the genetic lottery turns up. To accept whatever it doles out is genetic fatalism, and a rejection of the wholeness of human existence. To glory in such determinism would be a strange irony indeed for Christian thinkers. There is a mystery, but it is not in the science. It is in how we approach the world and use the science; it is the mystery of life, of compassion, of commitment to one another, of worship, and of purpose. That mystery will remain, regardless of the depth of our scientific understanding, and regardless of cloning.

A related argument against cloning is that it exceeds the limits of the delegated *dominion* given to the human race by God[12], because humans were not given the authority to alter their nature or the manner in which they come into existence. Consequently, cloning has been likened to eating the fruit from the forbidden tree in the Garden of Eden, that is, delving into the knowledge of good and evil. But why is altering some aspect of our nature doing this, if many other illustrations of medical control are not also condemned in like manner? It is sometimes inferred that the biological nature of every person is untouchable, and therefore beyond the reach of scientific investigation. Once again, this tends to be applied selectively; prenatal existence is untouchable, postnatal existence is not. Far more theological justification is required before such distinctions can be made and the boundaries of delegated dominion drawn in this precise manner. It is imperative to enquire whether the arguments put forward by Christian voices are convincing, and even whether they reflect essentially Christian perspectives.

A commonly encountered problem with many of these arguments against human reproductive cloning is that they are based on worst-case scenarios, thereby serving as a mirror for our fears and apprehensions. They also tend to support the natural as opposed to the artificial, and the uncontrolled as opposed to human control. Once again, this points to a lack of trust in human intervention. Inevitably, therefore, they leave little room for scientific intrusion into the reproductive process. A concern at unfettered scientific imperialism is healthy, as is scepticism at proposals for the mass cloning of humans. Similarly, a questioning of extensive scientific intrusion into human reproduction is to be encouraged. However, all of this can be accomplished without rejecting the scientific endeavour and the benefits that scientific intrusion into reproductive processes can bring. If such rejection is viewed as the only alternative for

Christians, the outcome for those who recognize value in science-Christian dialogue could be disastrous. It is against this background that I shall argue that a Christian theological perspective does not lead inexorably to a complete rejection of all science in the cloning area.

Alternative theological perspectives

A prominent argument against human reproductive cloning is based on the uniqueness of humans, on the assumption that clones would not be unique. However, if clones were to have identical genotypes, the two individuals concerned would have different phenotypes (just like identical twins), a different sense of self, different brains and thought processes, and different ethical responsibility[7]. Their biological uniqueness would remain, let alone their spiritual uniqueness. For Peters[19], individuals' uniqueness also lies in their relation to God, something that is not determined by DNA; it depends on God's active grace, and on God's love for us. Our value relies upon our alien dignity, bestowed by God and independent of our genetic status. Our identities in society come from growing into society, while our identity before God comes from God's ongoing grace and from our desire, or lack of it, to live in close communion with him.

This is not an argument in favour of cloning, but a plea for good arguments. We should still be concerned about the cloning of humans, mainly because the practice has the potential to commodify children. We should never come to think of children as products, nor merely as the outcome of quality control technological reproduction. By all means let us sound warning sirens, but this is not the same as banning human cloning. We have already moved into a world of expanded reproductive choice, and this should be guided by an ethical vision according to which children are treated with dignity even when they are the product of advanced reproductive technology. Such children are the gift of this technology, just as they are God's gift and just as God loves them as much as he loves everyone else. A thousand human clones would all be unique individuals, and they would all be loved by God.

Another response is that of Ronald Cole-Turner[20], who is suspicious of the argument that cloning violates the natural order of sexual reproduction. While recognizing that children may have a distinct advantage by having two genetic parents, he contends that "Christians find their best clue about nature by looking at Jesus Christ, where we see nature rightly related to God and where we see its destiny prefigured in Christ's

resurrection". For him, it is in Jesus Christ that we see a welcoming of children transcending genetic parentage. In view of this, Cole-Turner[20] goes as far as to say that, while cloning may not be something Christians will choose, neither should they attempt to prohibit it. It may even be a procedure about which they should be relatively indifferent.

Underlying the discussion so far have been a number of theological themes, which I shall now explore in more depth. The issue is whether human reproductive cloning could be contemplated by Christians under certain circumstances, or whether it should be forbidden as something too abhorrent for civilized societies to contemplate.

Creation as a completed act

Christian writers adamantly opposed to cloning view creation as a completed act. The natural world as we know it reflects the world created by God; it is a given. Hence, humans are not to tamper with God's good creation, nor with the make-up of humans themselves. Put simply, God's likeness cannot be improved upon. Consequently, human nature must not be modified in any way. The manner of bringing humans into the world is a given, as is the organization of our bodies and brains, suggesting that boundaries have been placed around them, boundaries that are not to be transgressed.

It is true that boundaries were set in the Old Testament, for example prohibiting sex between humans and animals (Leviticus 18: 22-24; 20: 12, 15-16); cross-breeding animals, and planting a field with different types of seed (Leviticus 19: 19; Deuteronomy 22: 9). However, it is not self-evident that these boundaries provide infallible guidance to cloning. Why were these boundaries erected, what was the rationale behind them, and is this relevant when we think about human cloning? The Old Testament boundaries were intensely practical ones, and we have to exercise considerable wisdom in deciding what the boundaries are, and where they are to be placed.

Viewing creation as a completed act leads to an acceptance of the world as we know it, and yet few would push this interpretation too far. It features prominently in the genetic and prenatal areas, but is largely ignored in other biomedical areas. More usefully, it leads to an emphasis on therapy as opposed to enhancement, that is, rectifying disease and that which has gone wrong, as opposed to attempting to improve upon that which has been given. This is a useful guide in most situations where

disease is the focus. Paradoxically, cloning does not fit into the enhancement category, unlike some forms of gene manipulation which would. Cloning is something of an enigma, since there may be circumstances where it would have overtones of therapy (comparable to the therapy of the artificial reproductive technologies).

Creation as a transformative process
According to this approach, God moved the world from a chaotic nothingness to an ordered light-filled, life-bearing place. He improved what existed. If God's creation is viewed in this manner, what lies at the heart of creation is God's good purposes and not a particular form of creation. From this it follows that humans might have a role to play as creators, especially since our creation in God's image emphasizes our creativity & inventiveness. When we act as stewards of God's creation, we put our creativity to work to assist the remainder of creation. Hence, our God-ordained creativity is to be employed in a variety of major endeavours: to overcome disease, alleviate poverty and hunger, expand the wealth of human achievement, and develop technology across many broad fronts.

Seeing God's hand in the uncertain and mysterious is relatively easy, whereas seeing his hand in what we can control is more difficult. Cloning and genetic engineering offer the prospect of removing some of that randomness and uncertainty, but would this undermine the belief that humans are created by God in his image? My argument is that it would not, since we will be left with the wonder of creation and the gift of new life, regardless of how it is actually brought into existence. It is the gift that is significant rather than the means employed, as long as the means are ethical and worthy of our status as human beings who image God. Nevertheless, we need to exercise enormous caution as we transform the world. If undertaken in isolation of God it can lead to disastrous consequences.

The concepts of creation as a completed act, and as a transformative process, do not entail completely separate approaches to the world. In practice there is overlap between them. The givenness of our world and our ability to transform it are both limited pointers to how we act in the biomedical arena, and more precisely how we face up to the possibility of human reproductive cloning. Unthinking acceptance of cloning, just like unthinking rejection, will be found wanting. We are to walk a middle path, seeking to transform what needs to be transformed but gratefully accepting much else as given. Guidelines will be found in what is good for human beings and what will best serve them and their lives in community with other human beings. It is the motives and end-result that

are crucial, not the cloning itself.

Eden and Babel
In Eden the human creature is given dominion over the garden with responsibility to till and keep it (Genesis 1: 26; 2: 15). The dominion is limited (Job 39-41). The world was not created by us or for us. We are to enjoy it, and we are to develop it judiciously as stewards. That is one side of the picture. The other side is provided by Babel (Genesis 11), where we are confronted by ambition and the desire to be like God. In this picture, the role of steward has been overlooked, and everything is trampled underfoot as efforts are made to control and master for the sake of mastery.

Both pictures apply to humans with their God-like abilities, and we have to take both seriously because our abilities can be harnessed for good uses, or they can be wielded for destructive ones. Neither tells us to sit back and do nothing; each is a reminder of what we are to do but also of where we can go wrong. Their power lies in their general sense of direction. They will not tell us whether it is appropriate to go in the direction of human cloning, nor whether we should stand back and totally reject cloning. They will not provide categorical directions, because as human beings we have to decide how to use our abilities and choose the paths along which we are to travel.

Stewardship
Underlying the Eden metaphor is a stewardship ethic (Genesis 2: 15), according to which God appoints his stewards to work in, and take care of, God's garden. This works itself out in three ways (Genesis 1: 28): to fill, rule, and care for the land[21]. As stewards, humans are accountable to God for the manner in which they carry out these crucial tasks, and this necessitates an appreciation of the dimensions and limitations of their responsibility. What it does not do is automatically circumscribe the task and place huge areas off-limits. It is interesting that, in exploring where the 'filling' command may lead, Reichenbach and Anderson[21] interpret it in a qualitative manner, in that it could include helping humans to become more disease-resistant, genetically superior, and better adjusted to and able to cope with their environment. In other words, humans may well be encouraged to change the creation for the better should that prove possible.

This ethic recognizes technology as a gift to be used to benefit some,

while not degrading or devaluing others. As we act on behalf of God, technology is to be used to meet human needs. The driving force should never be human hubris, but a longing to meet basic human needs. In these terms, certain forms of cloning may prove acceptable, although others with egotistical goals will be roundly condemned.

What we have here is openness to future possibilities alongside an awareness of our responsibilities for the welfare of human beings. Such an approach should lead to extreme care and caution about where science might take us, an awareness of the limitations of our abilities and of our readiness to misuse them, and a restrained optimism about where genetic research will take us.

Searching for a Christian ethos

What is at stake is the image we have of ourselves as human beings in relation to nature and in relation to our growing powers of mastery over nature[22]. One perspective sees humans as being *over and against* nature, as controllers and possessors of nature. A second regards people as being *under* nature, thereby prohibiting interference with the natural order and natural processes. According to a third perspective, human beings are *in* nature, exercising stewardship over it, and in so doing being responsible to God. Many Christian writers display elements of the second position, with its unwillingness to exercise control over nature, at least when that control is of human beings. The third perspective, by contrast, has more of the hallmarks of the Christian story.

A perspective that views human beings as *in* nature may allow for some types of cloning. Of course, moral caution is always appropriate, a caution born of humility rather than fear, and based on a view of dominion that places greater emphasis on care-taking than on conquering. Dominion of this order is characterized more by nurturing than controlling, and prefers to suffer patiently with nature than lord it over & against nature. This, in turn, is only made possible by a view of human beings that sees them as creatures subject to God the creator. We are to recognize that the fundamental problems of coping with human existence cannot be solved technologically. Greed and pride are not technological problems awaiting a technological fix; they are human faults which, in some instances, can be diminished technologically[22].

It is not a question of being pro- or anti-technology, any more than it is a

question of being pro- or anti-cloning. We are not to idolize the natural and demonize the artificial, just as we are not to worship the artificial and expect far too much of it. Human cloning will fit in somewhere along this uneasy continuum, the controlling factor always being human well-being; if this is not thought to be attainable, there is no room for human reproductive cloning under any circumstances.

Needless to say, the current state of the science of cloning must always direct our scientific and clinical gaze, and this also has implications for our moral gaze. At present, attempts to clone individuals, whether sheep or mice let alone humans, are fraught with uncertainty. This uncertainty alone is sufficient to render any attempts at human reproductive cloning profoundly unethical. It is likely that this situation will change at some future time, but even then clones will differ from their progenitors (if only because of extranuclear DNA). They will not be nearly as similar as identical twins.

We cannot avoid walking a tightrope. On the one hand, the unknowable and the uncontrollable are of value to us, as are our inabilities, and that which is given rather than made by us[23]. Awareness of what we cannot do, and perhaps will never be able to do, is a crucial antidote for arrogance, conceit, and undue self-confidence. All these characteristics stem from the emphasis on humility, weakness and vulnerability so eloquently demonstrated by Jesus. But there is another side as well: we cannot escape the control we exercise as human beings, control over our environment, and control over others in the human community. Even as we are aware of its limitations, we exercise control - with or without technology. Control is used to change the lives & prospects of others; it is used to bring some individuals into existence and to deprive 'others' of existence. And herein lies ambiguity. Is it God who is determining which new human beings will exist and which will not, or is it the scientific actions of human beings? In my view it is both, because we cannot separate the two, as long as the human actions are directed at improving the well-being of others. It is not an either/or choice, since the dilemma is not about control as such, nor about when it is administered, but about its direction. And this is where Christian discernment comes into play.

A Christian ethos is characterized by the motivation and aspirations of the people of faith, rather than by some outward conformity to regulations regarding which forms of technology are or are not acceptable. This is something we find intensely difficult to grapple with, because a pure

heart is far more demanding than well-regulated conformity. It is far easier to say 'no' to all forms of cloning, and to reject scientific initiatives into understanding and controlling the earliest stages of human development, than it is to establish criteria for when they may or may not be employed. The former requires a political dictate, the latter requires mature moral discernment.

In St Giles' Cathedral in Edinburgh, one of the wall plaques stands out. It thanks God for the discovery of anaesthesia by James Stewart Young in 1836. Other plaques are more conventional as they praise God or simply remember some outstanding churchman or theologian. There is nothing wrong with such sentiments, but they vastly outnumber those which remember a scientific discovery or medical advance. As I stood and contemplated that plaque a little time ago, I wondered whether a similar plaque will one day grace that same cathedral, thanking God for the contributions of Ian Wilmut, working just outside Edinburgh, in opening the way to cloning.

For some, any such thought is anathema. How can God possibly be thanked for such a development? But why not? As our successors look back at cloning and at what it may one day have achieved towards human welfare, they may well feel that this is a work of God[7]. Of course things may work out differently. Either way, what we have here is a fascinating balancing act between the process of scientific achievement and ongoing social, ethical, & theological debate. Both the achievement and the debate are required, since both mirror what we are as human beings. It is such a pity that so many, including so many Christians, are fearful of the science and ignore the fact that in the final analysis the world in which we live is God's world.

—-

Q: Do you know of any Muslim theologians who have commented on cloning or suchlike?

Jones: No I don't; in reproductive technologies yes, but cloning no I don't. They tend to be fairly liberal. As one meets Muslims in bioethical circles worldwide, their viewpoints are quite liberal rather than conservative by Western standards.

References

1. Cameron N M deS. The New Medicine. London: Hodder and Stroughton 1991.
2. Torrance T F. Test-Tube Babies. Edinburgh: Scottish Academic Press 1984.
3. Jones D G. Manipulating human life: the ambiguous interface between science and theology. *Colloquium* 1994 *26*: 17-31.
4. O'Donovan O. Begotten or Made? Oxford: Clarendon Press 1984.
5. Mitchell C B. Genetic renaissance in a moral dark age. Commentary provided by The Center for Bioethics and Human Dignity, web site 26 June 2000.
6. Kolata G. Clone: The Road to Dolly, and the Path Ahead. New York: William Morrow & Co 1998.
7. Jones D G. Clones: The Clowns of Technology? Carlisle: Paternoster Press 2001.
8. Kass L. The wisdom of repugnance. In: Flesh of my Flesh:The Ethics of Cloning Humans, (ed) Pence GE. Maryland: Rowman and Littlefield 1998 pp.13-37.
9. Ramsey P. Fabricated Man: The Ethics of Genetic Control. New Haven: Yale University Press 1970.
10. Bruce D. A view from Edinburgh. In: Human Cloning: Religious Responses, (ed) Cole-Turner R. Louisville: Westminster John Knox Press 1997 pp.1-11.
11. Evans A R. Saying no to human cloning. *in* Human Cloning: Religious Responses, (ed) Cole-Turner R. Louisville: Westminster John Knox Press 1997 pp.25-34.
12. Grabowski J S. Made not begotten: a theological analysis of human cloning. Ethics Med 1998 *14*: 69-72.
13. Meilaender G. Begetting and cloning. *in* Flesh of my Flesh: The Ethics of Cloning Humans, (ed) Pence G. Maryland: Rowman and Littlefield 1998 pp.39-44.
14. Jones D G. Manufacturing Humans. Leicester: Inter-Varsity Press 1987.
15. Jones D G. Valuing People. Carlisle: Paternoster 1999.
16. Snowden R. Mitchell G D. Snowden E M. Artificial Reproduction: A Social Investigation. London: George Allen & Unwin 1983.
17. Golombok S, Cook R, Bish A, Murry C. Families created by the new reproductive technologies: quality of parenting and social and emotional development of the children. *Child Dev* 1995 *66*: 285-298.
18. Golombok S, Brewaeys A, Cook R, Giaruzzi M T, Guerra D, Mantovani A *et al*. The European study of assisted reproduction families: Family functioning and child development. *Human Reproduction* 1996 *11*: 2324-2331.
19. Peters T. Cloning shock: a theological reaction. *In* Human Cloning: Religious Responses, (ed) Cole-Turner R. Louisville: Westminster John Knox

Press 1997 pp.12-24.
20. Cole-Turner R. At the beginning. In: Human Cloning: Religious Responses, (ed) Cole-Turner R. Louisville: Westminster John Knox Press 1997 pp.119-130.
21. Reichenbach BR, Anderson VE. On Behalf of God. Grand Rapids: Eerdmans 1995.
22. Bouma H, Diekema D, Langerak E, Rottman T, Verhey A. Christian Faith, Health, and Medical Practice. Grand Rapids: Eerdmans 1989.
23. Van Tongeren PJM. Ethical manipulations: an ethical evaluation of the debate surrounding genetic engineering. *Human Gene Therapy* 1991 *2*: 71-75.

Atheistic Science: a broth of contradictions

Neil Broom

Presented abbreviated as a lecture to the symposium 'Science and Christianity' to honour Harold Turner and John Morton, Auckland 01-4-21.

The title for this talk could well be misconstrued. It is certainly not my intention to imply that atheists don't practise good science. Indeed, probably the majority of scientists are philosophically either atheists or agnostics. The point I wish to make in this talk is: any science that denies the transcendent is, ultimately, a disjointed, incomplete science.

In 1976 I changed research directions, switching from inert crystalline materials to living materials. Not ever having studied the biological sciences I enrolled in the Stage 1 Zoology and Biology papers at the University of Auckland. As part of this course of study 10 beautifully presented lectures on evolution, accompanied by somewhat densely worded, decidedly 'old-world' handouts (at least by today's PowerPoint®-smitten standards), were delivered by Professor John Morton - and, I might add, with scrupulous disinterest.

During the tenth lecture John announced that he would offer an optional lecture for those interested, which would not be part of the formal course work. In this lecture he gave the class a glimpse of the vaster horizon that lay beyond the raw science of the preceding. He stated clearly his own belief that science simply cannot give us the complete picture of reality. His accompanying handout concluded with the following statement:-

> In my personal view, the cosmic process reaches beyond the biosphere and noosphere, into a still closer unification and intensification, and to the manifestation of still other values. The territory these involve is however, one of belief. It is really neither appropriate nor permissible to deal with these things before an academic (let alone a captive) audience! At a suitable time and place, I will consider giving a closing lecture on a

> process that has begun with science but certainly does not culminate with an intellectual or scientific mode of handling.[1]

This restrained, discretely-worded statement by John contrasts strongly with the strident, supremely confident naturalistic spirit that is all too often found in the contemporary presentation of science. Scientists are in many cases much less restrained in the way they declare their personal beliefs and operational frameworks. The popularisers of science receive generous patronage from the media machine, particularly in their promotion of naturalism's number one commandment - "thou shalt only think materialistically".

We are also witnessing the invasion by this same materialistic spirit of territory traditionally regarded as the rightful domain of metaphysics. I most certainly welcome a genuine integration of the seen and unseen dimensions, but when science makes the claim that only the material is real it has exceeded its proper bounds and has become a rude & destructive trespasser. I can well recall some years ago the debate over whether or not there should be a formal integration of papers offered at the various theological colleges in Auckland with the degree structure in this university. Within my own faculty dissenting voices mocked as absurd the very idea that theology might have something relevant to say in the modern world. We might well recall the timely warning issued by John Henry Newman one and a half centuries ago when he argued that theology is a profoundly important branch of knowledge and that the exclusion of a theological professorship from the university was an intellectual absurdity. Newman went on to say:-

> ". . . if you drop any science out of the circle of knowledge, you cannot keep its place vacant for it; that science is forgotten; the other sciences close up, or, in other words, they exceed their proper bounds, and intrude where they have no right . . . they would be sure to teach wrongly where they had no mission to teach at all.[2]

The purpose of this paper is to offer what I believe is a more integrated picture of science and the religious or transcendent dimension. I am not going to draw on any complicated science; rather, I will use quite ordinary & commonplace observations to make my several points. I will try to show not only that science cannot give us the complete picture but also that its own integrity as an intellectual craft requires something

beyond & above the purely material categories that this same science is so superbly equipped to handle.

While in Chicago recently I made a brief visit to the Field Museum of Natural History. My curiosity was drawn to the 'Life Over Time' tunnel on the second floor of this prestigious institution. Just inside the display entrance I spotted a glass case display, an assemblage of pyrex flasks & tubes easily recognisable as Stanley Miller's historic experiment.

Now the name Stanley Miller may not mean anything to some of you here today so I should briefly explain that in 1953 this young PhD student and his supervisor the Nobelist Harold Urey at the University of Chicago created a dilute solution of amino acids by supplying heat and electrical sparks to a mixture of simple gases – hydrogen, methane, ammonia - and water.

Miller's work stirred considerable excitement in both the scientific world and the media. Amino acids are the building bricks of proteins from which living organisms are constructed; so here, it seemed, was experimental evidence suggesting that something approaching life could be produced in a test-tube using inferred primitive-Earth conditions and entirely non-living ingredients. Now, almost 50 years on, the explanatory write-up in the Field Museum exhibit reads as follows:-

> A breakthrough in 1953 let us imagine life's beginning as a natural event . . . Miller's experiment broke our imagination barrier. Its message? Life could begin from chemical reactions between common materials found anywhere on earth.[3]

I use this one example simply to illustrate the crude, misleading messages that science all too often transmits to the public in the interests of protecting its reigning paradigm - scientific naturalism. For, despite its recurring presence in both prestigious museums and modern elementary textbooks, Miller's experiment offers virtually nothing of any merit in solving the problem of life's origin. It is true that most of the 20 amino acids which are found polymerised in proteins can be produced under relatively simple material conditions as the Miller experiment rather nicely illustrates. And proteins are vitally important to living organisms. But all this tells us virtually nothing about how such biological materials are integrated and shaped to produce even the simplest living creature.

The following analogy may be helpful. Nearly all the commonest minerals in the earth's crust are silicates of one form or another. The basic unit is the silicate pyramid constructed from four oxygen atoms surrounding a silicon atom to form a tetrahedron, and this tiny structure is produced by the action of entirely material forces. A clay particle is, in turn, constructed from a repeating array of these pyramids. Bricks are constructed from fused clay particles, and a stately mansion can be assembled from these bricks. But no-one in their right mind would expect to order the construction of a stately mansion merely by specifying that it be constructed from silicate pyramids. Rather, we are required to provide ever-increasing levels of creativity, beginning first with the shaping of our clay into regular bricks and then assembling these in accordance with the ideas embodied in the architect's design. What is needed is a *conscious agent willing that a plan be realised*.

Yes, our stately mansion certainly relies on all those tiny silicate pyramids predicted entirely by the known laws of chemistry. These laws are crucial to the construction of any purposeful system whether it be our stately mansion, a haemoglobin molecule, or a fingernail shaped from the protein keratin. But these same laws play only a servile role, for all such systems are crucially dependent on the input of higher principles that transcend the purely material.

Scientific materialism or naturalism denies the existence of this transcendent or mindful dimension, and in its account of the origin & development of life asserts that purely material processes, acted on by the sieving action of natural selection, are sufficient to give us the entire 'book of life'.

I need to digress briefly at this point. What is not under scrutiny in my presentation is the evolutionary unfolding of life. Rather, I am attempting to challenge the wholly material explanation, almost universally voiced by contemporary science, for the vast edifice of life. This explanation is known as neo-Darwinism or the synthetic theory of evolution.

Neo-Darwinism is, in essence, a synthesis of key elements that have been developed, debated & modified since the time that Charles Darwin formulated his own theory of evolution. Darwin's main thesis was the transformability of species - 'descent with modification'. Darwin in England, and almost simultaneously Alfred Russel Wallace on the opposite side of the world, proposed that this transformability arose from

the interplay of three principles:
(1) that all forms of life varied slightly;
(2) a conserving but mysterious mechanism operated whereby similar characteristics of form are transmitted from one generation to another;
(3) the living organism is faced with a struggle as it pits itself against its immediate environment. Those variants of a given species that cope best survive and reproduce, and, as a consequence undergo organic change through subsequent generations - *i.e.* they evolve.
Thus we have the full title of Darwin's monumental work - *The Origin of Species by Means of Natural Selection* (1859). Wallace had quite independently arrived at virtually the same idea as Darwin and outlined his theory in an essay titled *On the Law Which Has Regulated the Introduction of New Species* (1858).

Darwin believed he had discovered in natural selection the very mechanism that would explain what previously had required some form of vitalism or divine guidance. He wrote:-

> It may be said that natural selection is daily and hourly scrutinising, throughout the world, the slightest variations; rejecting those that are bad, preserving and adding up all that are good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic conditions of life.[4]

He was acutely aware of the potential confusion conveyed by the expression 'natural selection', and sought to reassure his readers that it did not imply conscious choice or the active power of God. He went so far as to say that in a literal sense it is false:-

> Some have even imagined that natural selection induces variability, whereas it implies only the preservation of such variations as arise and are beneficial to the being under its conditions of life. . . . In the literal sense of the word, no doubt, natural selection is a false term.[5]

Unknown to Darwin an obscure Augustinian priest, Gregor Mendel, had unravelled the main principles of inheritance but his remarkable experiments remained largely unnoticed until the Dutch botanist Hugo de Vries in 1900 alerted the world to their profound significance. De Vries himself had conducted a huge & painstaking series of breeding

experiments with the evening primrose and established the undeniable fact of mutation - that sudden discontinuous changes may arise spontaneously to produce new, stable organic forms.

It was left to the mathematical biologists in the earlier part of the 20th century to find a way of integrating into a single unified theory Darwinian natural selection, Mendelian inheritance, the mathematics of the gene pool, and mutation as the ultimate source of new genetic material. This was the grand synthesis known today as neo-Darwinism.

Just as Darwin rejected any thought that natural selection was anything more than a purely impersonal mechanism by which variations in a species are systematically gathered up to produce a gradual increase or evolution in complexity, so also the neo-Darwinist asserts that natural selection is a force capable of performing the most extraordinary feats of biological transformation and is yet a power wholly without purpose, foresight or intelligence.

The popular monthly science magazine *Scientific American* published an article in 1999 surveying the religious beliefs of contemporary scientists. The article makes fascinating reading in its canvassing of a wide horizon of viewpoints from militant atheism, religious naturalism right through to conservative evangelicalism. Perhaps the most intriguing response came from National Academy of Sciences member and evolutionary biologist John Avise who dismissed any suggestion that the universe might point to life having a deeper and ultimately transcendent origin and meaning. Avise declares that:-

> Only natural selection comes close to omnipotence, but even here no intelligence, foresight, ultimate purpose or morality is involved. Natural selection is merely an amoral force, as inevitable and uncaring as gravity.[6]

Similarly Richard Dawkins, one of contemporary naturalism's most articulate and persuasive voices, states that:-

> Natural selection - the blind, unconscious, automatic process which Darwin discovered is the explanation for the existence and apparent purposeful form of all life, has no purpose in mind.[7]

But note in these same passages the language that is used: natural

selection is said to be “close to omnipotence”, “uncaring as gravity”, and it indicates only “apparent purpose”. It is this kind of doublespeak, all too frequently uttered by the biological materialist, that illustrates the fundamental dilemma facing hardcore naturalism. Clinging resolutely to the belief that reality is ultimately lifeless matter, the biological materialist confers on natural selection the status of a sacred utterance, a mantra, an incantation that turns the blind, unthinking processes & ingredients of the material world into the grand edifice of life.

Although the reigning paradigm for the materialist is always mindless materialism, the narratives & images frequently employed often tell a very different story. Take for example Dawkins’ explanation of how the eye evolved. He argues that under the sieving action of natural selection there is a continuum of seamless development by tiny gradual steps from a simple light-sensing layer of pigmented skin cells right through to the sophisticated mammalian eye. This is precisely what Darwin had proposed much earlier:-

> . . . if numerous gradations from a simple and imperfect eye to one complex and perfect can be shown to exist, each grade being useful to its possessor, as is certainly the case; if, further, the eye ever varies and the variations be inherited, as is likewise certainly the case; and if such variations should be useful to any animal under changing conditions of life, then the difficulty of believing that a perfect and complex eye could be formed by natural selection, though insuperable by our imagination, should not be considered subversive of the theory.[8]

It is, of course, how many of our own technologies advance - small steps of improvement leading eventually to a better product or system.

Now one argument often raised against the kind of gradualism described by both Darwin and Dawkins is that a highly complex, integrated organ such as the human eye could not have evolved by a step-by-step process. Rather, it must have required the coordinated integration of all its parts, their evolving in synchrony, so as to produce the fully functioning organ. Nonsense, says Dawkins:-

> Vision that is 5% as good as yours or mine is very much worth having in comparison with no vision at all.[9]

and:-

> A simple, rudimentary, half-cocked eye . . . is better than none at all. Without an eye you are totally blind.[10]

Here, Dawkins is perfectly correct. No one in their right mind would disagree that a poor eye is better than no eye at all. But Dawkins is, I believe, pushing our credulity just too far, for he then says

> . . . part of an eye is better than no eye at all.[11]

and

> An ancient animal with 5% of an eye . . . used it for 5% vision.[9]

This is plain nonsense, nothing more than crude, pseudo-scientific sloganeering. Dawkins fails to distinguish between a crude eye that actually sees and something that represents just part of an eye, a part that is itself incapable of seeing at all. Even the crudest or most primitive eye is a going concern, *i.e*. it "sees" to some limited degree**.** But a part of an eye is not a going concern and therefore cannot be placed within a seamless continuum of increasing seeing function which could be open to selection.

Yet, in another very real sense Dawkins can claim to be correct - but at the expense of betraying his own naturalistic principles. In terms of the achievement of sight, part of an eye is better than no eye if one is actually *aiming* to produce a seeing organ. This principle becomes a little clearer if we think of the achievement of powered flight.

The Wright brothers 'took off' in December 1903 because they met the very minimum requirements for powered flight. They devised and constructed a machine that was, aerodynamically speaking, minimally competent. And although the performance of that Wright Flyer was nowhere near that of the modern jumbo jet, both have flown. Just as there are degrees of flying performance so there are degrees of seeing. When we talk about an improved flying performance of say 1% we are improving *actual* flight. We cannot have improved flight without some flight in the first place. 1% or 5% of a plane will not fly. Strange though it might seem to the biological materialist committed to unthinking gradualism, a rivet won't actually take off! But even a humble rivet will contribute to the achievement of flight *if flight is being aimed for.*

Orville Wright first flew for those 12 momentous seconds in Flyer I because he and his brother Wilbur zealously *sought* powered flight. When they shaped their propellor at their workshop bench they knew it would contribute to the achievement of flight even though the propeller, of itself, could not fly. But this is to admit to a purposeful, nonmaterial goal that is being sought by an act of will, by a conscious agent.

Now in case I am accused of misrepresenting Richard Dawkins it is instructive to examine his account of eye evolution in his more recent book *Climbing Mt Improbable*. He exploits a computer model devised by two Swedish biologists Dan Nilsson & Susanne Pelger[12] which 'evolves' a virtual eye object from a flat layer of virtual cells sandwiched between virtual pigmented and transparent layers. The model works - and always in a virtual sense - by producing at random small percentage changes in the degree of curvature of the sandwich, in the size of a light-restricting aperture, and in the local value of its refractive index (light-bending ability). The computer is programmed to perform a simple calculation of the sandwich's focussing or resolving power every time a random change (read virtual mutation) occurs in the three variables.

In a relatively small number of generations the computer model is shown to transform the flat sandwich layer through continuous minor improvements into a configuration representing a virtual, focussed eye lens-shaped object. For Dawkins this transformation is exactly analogous to climbing the mountain of biological complexity:-

> Going upwards means mutating, one small step at a time, and only accepting mutations that improve optical performance. So, where do we get to? Pleasingly, through a smooth upward pathway, starting from no proper eye at all, we reach a familiar fish eye, complete with lens.[13]

However, even the most casual reader should immediately see that Dawkins' supposedly wholly material explanation is anything but material. He is required to impose a non-material constraint on the behaviour of the eye model - he inserts the most crucial proviso of "only accepting mutations that improve optical performance." Or, in terms of his mountain-climbing analogy, one must aim for the summit. He is thus required to introduce a profoundly *purposeful* dimension. The absolutely indispensable element of goal-centeredness is built into his supposedly naturalistic scenario.

In fact, intentionality is woven right through the fabric of Dawkins' neo-Darwinian story-telling, and in various forms of disguise[14]. Consider for a moment his attempt to explain the evolution of insect flight where 'proto-wings' would not have provided useful lift unless they were already of a substantial length. Dawkins does admit that a different kind of explanation may be required to avoid any reliance on large single-step mutations in order to achieve some functional advantage that may be open to selection. He argues that the first insect wings, though useless for flight, may have been pre-adapted for a completely different purpose, perhaps furnishing the animal with heat-gathering solar panels. Darwinian selection might then have acted to increase gradually the length of these `wing stubs' thus providing a smooth gradient of improvement in solar heating performance for the insect. This increased size, he argues, would then have been exploited perhaps much later in evolutionary time for the very different purpose of flight.

Similarly Dawkins argues that feathers in birds may have evolved not initially for flight but for thermal insulation, or possibly as a kind of net for catching insects. Flapping movements might have come originally from the need for a tree-leaping animal to develop some degree of control over pitching and rolling movements, this being achieved by some kind of arm flapping, and evolving eventually into 'winged' power. One could similarly fantasise, *ad hoc*, the evolution of the hook structure (the frenulum) which loosely links the fore and aft wings of a moth, enabling the peculiar tandem operation of the two wings. Perhaps a tiny protuberance functioned, before it evolved so far as to link the wings, as an 'intercooler', conferring selective advantage by this temporary function! (Imagination is confused with fact in too many neo-Darwinian discussions.)

Although superficially plausible, Dawkins' attempted sideways diversions do nothing to get round the fundamental issue the neo-Darwinist so desperately seeks to avoid - that all-important element of intentionality or purpose in the living world. His evolutionary diversions merely shift the problem into a different biological realm: for even if it could be shown that wings did evolve originally as thermal panels he is still required to express the gradual increase in wing length in intention-laden language - they "become better solar panels". But why, we might ask, should anything in a wholly impersonal material world want to "become better" or improve? Dawkins has surely trespassed into that dread realm (at least for the materialist) of metaphysics where such non-material qualities most certainly belong.

He similarly speaks of muscular movements in 'proto-flying' animals that were used "to control glide direction, so average time to landing was postponed over evolutionary time". In discussing the flying squirrel with its special membranes of skin stretching from wrists to ankles he argues that its evolutionary ancestor possessing even a very slight flap of skin would have been able to leap that little bit further and in a critical situation "save its life". But such intention-laden language is surely a blatant contradiction of the materialistic assumption that lies at the very core of Dawkins' neo-Darwinism. All of the examples that he provides express that essential drive of the organism to achieve, to improve some aspect of its performance, to become! Dawkins' science, despite his claims to the contrary, most certainly does not describe a world where natural selection reigns as a "blind, unconscious, automatic process".

Sideways diversions that turn out to be advantageous are not uncommon, but they all require that intensely personal element of discernment, that ability to sense whether a particular innovation might have use for something else. The space race is a good example in that a number of technologies developed originally for the exploration of space have been exploited to great advantage in many earth-bound situations; and always because their usefulness has been recognised. Richard Dawkins, when he invokes sideways diversions to prop up his evolutionary gradualism, is in my view using a crude form of neo-Darwinian *ad hoc*-ery to disguise his real reliance on this essential, non-material element of intentionality or purpose.

Naturalism or scientific materialism claims to have explained living complexity in wholly material terms. But at almost every twist & turn in its arguments it lapses into a kind of personified, anthropomorphised depiction of nature, giving minds to molecules, which they do not appear to have. I argue that this is not merely a stylistic convenience that can be discarded when scientific rigour is required, but is rather an implicit admission by the materialist that life transcends the laws of physics & chemistry and thus requires a higher level of explanation.

So this is the predicament that confronts naturalism: it desperately needs something more than the material, but it dare not admit to this in public. In private, however, barely disguised in the images, narratives & metaphors it is compelled to use, it betrays this desperate need for a transcendent guiding force in order to provide a coherent science of life. Dawkins' mountain-climbing analogy is just one case in point.

As a scientist with an engineering background I have often wondered why it is that the biological sciences are so afflicted with the naturalistic spirit. Why, for example, do so many biologists cling so strongly to the belief that life was 'jump-started' (a popular phrase in current naturalistic jargon) by wholly natural means from some imagined chemical broth? Let me suggest some reasons.

If we think for a moment about the life sciences they all begin with an incredibly rich 'bank account'. Every biologist, by definition, begins with a superb, living inheritance - the fully functioning organism is there ready to greet the curiosity of the investigator. The biologist is cossetted by life. Whether it be a humble bacterium, a fruit fly or a cut finger, the biologist is presented with behaviour that is strangely different from anything seen in the non-living world.

For the biologist the 'default setting' is life. He or she is not required to *make* life, indeed cannot, but as a consequence may be tempted to think that because life cannot be made with the tools of science it has not been made at all. Rather, it has somehow sprung unaided out of the physico-material black box.

By contrast, the default setting for the engineer is unshaped raw materials. The engineer is required to think carefully & deliberately about how a particular piece of technology is to be created from these materials. Every act of engineering creativity is a powerful reminder that purposeful systems arise only from the expression of mind. There is no *mindless* evolutionary path from a crystalline array of iron atoms (steel) to an internal combustion engine. Yes, the internal combustion engine has unquestionably evolved with some sizable, cleverly executed leaps of technological innovation along the way. But this technological evolution has been driven by the intensely purposeful activity of a conscious agent. The engineer's creation comes at the cost of intellectual effort and deliberate design - what Michael Polanyi might have called a "profoundly informative intervention".

Unlike the engineer, the biologist is never called upon to struggle intellectually to see the living organism brought forth. We don't, indeed we cannot, make living organisms. They are there as a fundamental given. The microbes in the agar-filled petri dish oblige so generously by reproducing at a prodigious rate. We don't even *make* babies; rather, we are given the lesser task of firing the starting gun. But from here on the

magical journey of embryonic development proceeds with exquisite orchestration independent of any significant help on our part.

We attend to a cut finger but only in a crude, ancillary sense. We apply a bandage or even insert a stitch or two, but that truly remarkable healing response, which only the living organism possesses, is a gift of quite breathtaking generosity totally unmatched by anything we see in the world of non-living things. Let me quote a colourful passage from the writings of cyberneticist Leon Brillouin:-

> The living organism heals its own wounds, cures its sicknesses, and may rebuild large portions of its structure when they have been destroyed by some accident. This is the most striking and unexpected behaviour. Think of your own car, the day you had a flat tire, and imagine having simply to wait and smoke a cigar while the hole patched itself and the tire pumped itself to the proper pressure, and you could go on. This sounds incredible. It is, however, the way nature works when you "chip off" while shaving in the morning. There is no inert matter possessing a similar property of repair.[15]

Strictly speaking we cannot even talk about differences in behaviour between the living and non-living because non-living things don't actually *behave* at all. They just are. Atoms, molecules, crystals, rocks and water are all products of the material laws of nature. Some might argue that the electron orbits the nucleus of the atom and therefore displays a form of behaviour. But this is merely an imprisoned activity totally dictated or prescribed by the laws of physics.

Conversely, the living organism's behaviour is characterised by a quite remarkable extent of freedom. Yes, there are material laws which it must obey. The rules of chemical bonding are, so far as we know, fully honoured in the huge array of metabolic processes taking place within each individual cell of the living organism. But conformity to such material laws does not account for the behaviour of the organism itself. This is better likened to the performance of a majestic orchestral work. Its entire structure conforms to the rules of musical composition but the music clearly transcends these rules. The music is, vastly more, an expression of the creative imagination of the composer. And so it is in the living organism. Each of the myriad processes taking place within its

being obeys, uncompromisingly, the laws of chemistry and physics. But the organism is committed to a higher, transcendent calling. It plays its part in the magnificent symphony of life, performing with exquisite timing and anticipation each of its individual movements which include embryonic development, growth, repair, reproduction, and all those creative responses to the innumerable challenges posed by the outside world.

As we reflect on these quite staggering qualitative differences in behaviour between the living and non-living worlds it seems, at least to me, entirely reasonable to conclude that the phenomenon of life, including mankind itself, cannot be reduced to the play of wholly material forces. And in making such a claim I stand in excellent company. Michael Polanyi, one of the great thinkers of the last century, a distinguished scientist and philosopher, rejects the absurd reductionist myth which attributes the emergence of life and mankind to the play of material forces alone. I therefore conclude this paper with a brief passage from his monumental work *Personal Knowledge*:

. . . the rise of man can be accounted for only by other principles than those known today to physics and chemistry. If this be vitalism, then vitalism is mere common sense, which can be ignored only by a truculently bigotted mechanistic outlook.[16]

A brief postscript: admitting to a metaphor taken out of context, but inspired by the heart of the Easter message, I ask of the materialist – "why do you seek the living from among the dead?".

Dr Carolyn King: I refer to your next-to-last diagram, 'going upwards requires ...'. Like any Christian biologist, I can see a great deal that's extremely regrettable in what Richard Dawkins says; and I think it's absolutely essential that we should stand as Christians against the extremes of scientism which he represents. However, at the same time, as a biologist I also think it's very important that we don't reject biology for the wrong reasons. So could I please just stand in for Richard for a moment and explain to you what this analogy is about?

Where you criticise his saying 'you only accept mutations that improve optical performance', and you regard that as unacceptable, can I suggest that he does this as a genuine analogy for natural selection? What he's doing is saying that in a population of fishes which may have

different combinations of degrees of development of this eye-spot, some of which are slightly better than others, the ones which are slightly more capable of seeing enemies coming or food on the floor are going to do better than others. So it is natural that those will survive better and reproduce better. He's not talking about improving optical performance in any metaphysical sense except that that is how natural selection works.

So, yes, let's criticise science where it criticises theology on the wrong grounds; but I think in this particular case Dawkins' analogy is correct.

Broom: I think Dawkins should not be talking about 'improving' - the concept of betterment in his system is I think fallacious unless he admits that natural selection is actually towards achievement; in other words it's very goal-centred. I think he has to admit he is looking at a process that is ramping upwards toward increasing usefulness to the organism. He denies there is any goal-centredness in the living world. I think that, frankly, is a contradiction. I stand by and underline what I said: when Dawkins says 'only accepting mutations that improve optical performance' I think that's a denial of his materialism.

Dr Harold Coop: We've heard a lot about the 'primordial broth'. When I was a young student, in the middle of the last century, I read a book called 'Human Destiny' by le Compte de Nouy in which he calculated that the chances of protein molecules aggregating together to form self-reproducing purposive early organisms were perhaps some 256 billion against. He was a famous French scientist; you can find him on the Web still. I'm not sure that you mentioned this in your book, Neil, which I've read with admiration. I wonder if that calculated quantitative assessment of the possibilities of the primordial broth has been discredited.

Can I just leave you with one thought as an eye specialist? The most remarkable thing about the human eye is that it has evolved a way of reproducing itself by having an appendage on the back of it called the human body.

Broom: I don't think it's a lottery issue. Chance is not the issue. Michael Polanyi makes this point. We are looking at higher levels of control; even if an appropriate configuration of molecules could arise by chance, what is really important is that it is within a context that makes it meaningful. Science in its reductionistic drive has chopped things up so finely into such atomistic entities that it has missed the hierarchical concept of life. My illustration of the silica tetrahedra going right up to

the stately mansion should answer that question. Even if we could get a stately mansion created by chance, which is obviously of negligible probability, it would still have no meaning. The universe is packed full of significance. The *context* in which material things operate is really the key to understanding the hierarchical nature of existence. It would be hopeless trying to explain the purpose of the university on the basis of what the cleaners do at their level of functioning. They do not define the concept of a university, which comes from the top down. If you educate a cleaner enough, s/he might become the vice-chancellor; but that's something that is always imposed on the lower levels and can bring them up. It seems to me that you cannot avoid the concept of a higher level imposing somehow on the material world. The probability argument has been regularly advanced, but I think we need to go beyond that to the issue of hierarchy.

Q: I must agree with a previous speaker about your criticism of Dawkins, because it seems to me that he was only doing in his selection what natural selection would do. I didn't think your answer was quite adequate.

Also, the engineer who is designing something is reliant upon experiments made by others for his knowledge of how to design, say, a bridge; and if that is wrong, the bridge is liable to fall down. There is a process of selection.

Broom: I think we use this term 'natural selection' far too sloppily. I think it's actually life-promoting unnatural selection. It's an idea that has within it the concepts of survival, betterment, and increasing sophistication and I do not see how these can be derived from purely material categories. Dawkins is cheating when he uses 'natural selection' as a concept of improvement; he has exceeded the boundaries of his own naturalism. I would argue for a much more vitalistic concept of selection: it really is going somewhere, it is wanting to achieve. Dawkins' virtual model might work, given that approach. But it leaves a lot of other questions unanswered.

References

1 John Morton, Biology 101 course handout Nº 75/144, 1976.
2 J. H. Newman, *The Idea of a University* New York: Holt, Rinehart & Winston 1964, p.55.

3 Field Museum of Natural History, Chicago. Exhibit entitled “Life Over Time”, March 2000.
4 Charles Darwin, *The Origin of Species by Means of Natural Selection* p.84 London: J M Dent, 6th edn.
5 *Origin*, p.81.
6 E. J. Larson, L. Witham, Scientists and Religion in America *Scientific American* Sept 1999, 78-83.
7 Richard Dawkins, ‘The Blind Watchmaker’ p.5. Harmondsworth: Penguin1988.
8 *Origin*, p.167.
9 *Blind Watchmaker*, p.81.
10 *Blind Watchmaker*, p.41.
11 *Blind Watchmaker*, p.85.
12 Dan Nilsson & Susanne Pelger ‘A pessimistic estimate of the time required for an eye to evolve’ *Proceedings of the Royal Society, London B256* 53-58 (1994).
13 Richard Dawkins, *Climbing Mount Improbable*, p.151 Viking 1996.
14 *Climbing Mount Improbable*, ch. 4.
15 Leon Brillouin ‘Life, Thermodynamics, and Cybernetics’ in *Modern Systems Research for the Behavioural Scientist* , p.154. ed. W. Buckley. Chicago: Aldine1968
16 Michael Polanyi *Personal Knowledge: Towards a Post-Critical Philosophy*, p.390 University of Chicago Press 1962.

Causes in Biology

L. R. B. Mann

Presented abbreviated as a lecture to the symposium 'Science and Christianity' to honour Harold Turner and John Morton, Auckland 01-4-21.

This paper has been written in cooperation with Neil Broom over the past several years, inspired by one small part of John Morton's 1972 book 'Man, Science and God'[1] .

The four categories of cause, identified by Aristotle and little challenged for 2.3 millennia, have rarely been taught to science students. Two of the four are simply ignored today by the leading proponents of scientism such as Richard Dawkins, Lewis Wolpert, and Steven Weinberg. We suggest that Professor Morton's 1972 exposition of the 4 causes offers neglected potential to improve science and Christianity, *e.g.* by clarifying that murky, confused scene the theology of evolution.

The 'enlightenment' assumption that science can, and soon will, give an essentially complete description[2] and explanation of the physical (including biological) world had become widely influential, though little discussed, when we were science students. Since then, the limits of science and its proper interactions with other domains of knowledge have continued to be widely ignored. And even within science, little attention is directed to the question of what the word 'explanation' means.

Scientism is thus crudely asserted by mere implication, but not discussed. Scientism - faith in science as the "only" way of knowledge - has been in the ascendant for most of the time since the early 18th c. and has lately dominated scientific education by default. It is this last-mentioned aspect to which we most strenuously object. To neglect all mention of final cause is not good education (nor good philosophy); but to do so without any discussion is downright crude if not dishonest.

The term 'evolution' means the appearance of new life-forms - new species and bigger categories genus, family, order, class, phylum, kingdom - over time[3]. The idea that no new species have been created since the 6th day tends towards deism, which we reject in favour of

theism. We believe God created the universe out of nothing but did not then cast it adrift like some wound-up clockwork toy; He also has sustained it from moment to moment over 10^{10}y. Christians concentrate on the spiritual sustenance from God through prayer, sacraments, etc., but have accorded less attention to God's maintenance of the Garden for us to live in as His stewards while praising Him (that is what we are here for). One among the several senses in which John Morton's life has been dedicated & productive is his tireless advocacy that we conserve this, the only biosphere we know of, which God not only created & sustains but also lived in briefly as a man to inaugurate the Kingdom of God on Earth. The failure of modern man to conserve ecosystems remains one of the most distressing aspects of modern life, but somewhat less so for Mort's staunch advocacy of applied ecology.

Our care, or neglect, of the biosphere will depend on what we believe about how and why it came to be. What can be discerned about the process by which its creation has occurred over time? Fig. 1 shows its time-frame and main catastrophic ice-ages (which appear to have been usually followed by surges of new life-forms). Fig. 2 summarises the main facts of evolution as known from the fossil record[4].

Science has inferred from a large body of observations that life appeared on our planet as blue-green algae 3 x 10^9 year BC, complex animals 1 x 10^9y, mammals 2 x 10^8y, and man somewhere in the region 10^6 -10^5 y BC. Evolution has certainly occurred, in the sense that new life-forms have appeared (mostly in bursts) over billions of years. However, evidence for descent from one to another is much sparser than is often assumed, and is difficult to come by. Many links are missing from the fossil record found to date.

This proliferation of increasingly complex life-forms over time requires explanation - ascription of causes - beyond what has become standard evolutionary theory *viz*. random mutation, natural selection, genetics, and population dynamics - the four lines of scientific thinking which have been synthesised into neo-Darwinism. Dogged refusal to discuss is a main mark of ideologies as distinct from schools of thought. We fear that neo-Darwinism has degenerated to such an unfortunate dogmatic or ideological status. In our opinion, evolution theory deserves better.

We are here concerned with the causes of evolution. The evasion of final cause in biology is one explanation (in an age of trendy materialism) of the recent popularity of Richard Dawkins as a vigorous advocate of scientism. Broom has outlined[5] objections to Dawkins's approach.

Gradualism remains a dominant principle in orthodox Darwinism, although hardly a dominant characteristic of the actual record of evolution, which is mainly discontinuities or saltations.

We stress and deplore the fact that Dawkins attributes to molecules (DNA) the property of intentionality, even creativity in design - properties which, we suggest, cannot belong to molecules.

If evolution is so unplanned & meaningless as Dawkins claims, why does he never avoid goal-laden accounts of the process? *Can* evolution actually *be* described in purpose-free language? If not, that fact might suggest that evolution theory should include rather than ignore the concept of final cause.

That Dawkins could be so popular illustrates the need to clarify **explanation** and **cause**. What is to be explained in biology, and what will count as a thorough explanation *i.e.* a full attribution of causes?

In order to promote consideration of causes in biology, we go back to William Paley's 1802 scenario of finding, during a stroll on a heath, a watch. Paley argued that the evident order of this mechanism would rightly force the finder who studied it to infer the existence of a purposive design, and therefore a purposeful designer. (This reasoning would seem especially warranted if the watch was running when found.) He then argued that the living mechanisms of nature - the complex machinery so evident in biology - must similarly be inferred to have been designed. We believe this argument has been unreasonably neglected and certainly not refuted. Megatime is no substitute for purpose in the creation of coordinated working ecological order.

In the course of advocating revival of Paley's argument, we attempt to bring up to date the definitions of causes.

A scholar of Greek philosophy discussing Aristotle's four causes remarked[6] :-

> The aim of wisdom, he says, is to arrive at knowledge of causes and principles. A 'cause' gives the answer to the question 'Why?'. Generally speaking, the cause of anything is the coming to be of a particular form in the appropriate matter: 'matter' and 'form' are then 'causes' of a thing's existence. But for a complete account of the reason why anything comes to be what it is, a further analysis of form is required, and the original two causes become four.

Aristotle's original statement (in his *Metaphysics*) is translated in Flew's textbook[7] :-

Cause means:

(1) that from which, as its constitutive material, something comes, *e.g.* the bronze of the statue . . . ;

(2) the form or pattern, that is, the account of the-what-is-to-be . . . ;

(3) the source of the first beginning of change or rest, *e.g.* the man who resolves is a cause, . . . ; and

(4) the end, that for the sake of which, *e.g.* as health is of walking around. ('Why is he walking around?', we say; 'In order to be healthy', and having said this we think we have given the cause.) . . .

These are just about all the senses of the word cause, and since the term is multiply ambiguous there are regularly several causes of the same thing; for instance, the making of a statue and the bronze are causes of the statue . . . They are not, however, causes in the same sense, since the one is material and the other efficient.

Flew comments that in ordinary English the word 'cause' would, by someone quite untouched by Aristotelian influences, be applied only to the Efficient and Final causes (not, we may note, the pair favoured by the scientism that I'm criticising).

Two or three of the labels which have so long been standard are less than self-explanatory, or are even confusing - notably 'efficient' - but it is probably too late to change them.

The difference between #2 and #4, which have been termed Formal and Efficient, is not - in these, Aristotle's original definitions - very clear, but it might be fair to define efficient cause as a process leading to a specific new state; and the concept of purpose is clearly discernible in Aristotle's original wording.

Before the more recent decline in philosophy of science, Professor Morton, using science as Aristotle of course could not, clarified the 4 categories of cause in his 1972 'claret cameo'[1], which we here paraphrase.

What are the causes of my bottle of claret?

The **material** cause includes the grape juice and the yeast, materials transformed by the **efficient** cause into this peculiar substance claret. The efficient cause, as in Aristotle's prototypical example 'the making of a statue', is the action of the yeast on the grape sugars and some minor components, a process resulting in

aqueous ethanol and some minor chemicals characteristic of claret.

But my bottle of claret has also a **final** cause: a person (named Babich) exerted his will to organise suitable vessels & conditions for the substances which are the material cause, and planned a sequence of operations for the purpose of making claret by maximising the likelihood that the efficient cause for claret would operate *i.e.* the particular biochemical action of the yeast on the grape juice leading to claret.

Aristotle's **formal** cause is the 'claret idea' in Babich's mind.

The improvement is that the example of efficient cause in Morton's claret cameo makes clearer in terms of chemistry (as the pre-science Aristotle could not) the concept of a process for a purpose. We propose, as a clarification for the age of science, to define the efficient cause of X as a process of change involving matter &/or energy leading characteristically to X.

What then can be said to explain - ascribe the causes of - an organism? The blueprints encoded in DNA are material causes, and operate as parts of efficient causes through the several types of RNA and the many enzymes essential for synthesis of proteins & other biochemicals; but DNA is certainly not a final cause. As Professor Morton has recently put it, DNA is not the kind of thing that can cause other things, as if paints could leap from tubes to create a Turner, or vibrations & percussions form themselves into a work of Mozart. A person implementing a plan - a final cause, like Aristotle's prototypical 'the man who resolves' - is the only way such things can come to be.

If science consists of discovering materials and forms (*e.g.* species of organism) and elucidating qualitatively & quantitatively the processes - including energy conversions - which result in new physical situations, then material and efficient causes are the only causes science can study.

But we have found no reason to say that no final cause operates in biology. The neo-Darwinist approach simply *assumes* that efficient causes (with of course the material causes needed for them to operate) suffice to explain evolution. Emergent properties are assumed to be entailed in the impersonal laws of nature, to whatever arbitrary extent may seem desirable in the attempt to evade final cause.

The main exception is obviously technology - and more widely, all human acts to modify the physical world. The only type of final cause - person acting to cause a change - is, in this 'Enlightenment' approach,

human will. Thus 'who designed this watch?' is an allowed question, but 'who designed this frog?' not[8]. This assumption - an implied denial, rather than any reasoning - appears not to have been subjected to much scrutiny.

One point not at issue is that **emergent properties** are real & important. As matter takes more complex forms, new properties emerge which are absent in the simpler forms. To take an extremely simple example, the molecular substance H_2 (ordinary hydrogen) has more types of properties than does atomic hydrogen H, and science (mainly quantum mechanics) has gone some way toward explaining those emergent properties (*e.g.* vibrations & rotations seen by infra-red & Raman spectroscopy; nuclear magnetic resonance spectra; etc). But a phenomenon such as the emergence of the first seed-plant (a sequoia, 3×10^8y BC), with no known 'proto-sequoia' precursor, represents a scale & co-ordination of emergence requiring more detailed explanation. Science should continue to discover efficient causes in biology, but the working assumption that there are no final causes should not be viewed as a theological fact.

Perhaps the most advanced non-theological attempt to do justice to causes in biology is Waddington's concept, developed further by Sheldrake, of morphogenic fields. Sheldrake's ideas offer a main bridgehead for the re-connecting of science and religion; since we believe this to be a principal task facing today's world, we sketch Sheldrake's two key concepts here.

It is important to distinguish morphogenic[9] fields, the basic contribution of Sheldrake, from his secondary, far less supported, concept 'morphic resonance' which involves changes in the fields.

Sheldrake's concept **morphogenic field**, directly traceable to Waddington's concept 'chreode'[10], reminds us that the set of blueprints in DNA, a set specifying primary structures (*i.e.* sequences) for two great classes of macromolecules - nucleic acids and proteins - is not sufficient to specify life. Those linear listings may be necessary, but are not sufficient; the central biological problems of development and of adaptation have not been illuminated by hypothetical models, let alone facts, for how DNA sequences might co-ordinate these processes. The forming of an organism in development requires specifications for when, and where and how fast, to build from each respective DNA blueprint. Can, as a matter of logic, such a development plan be discovered by 'The Human Genome Project', which is only DNA sequencing? The chreode into which a fertilised frog egg grows, to become a frog rather than a dog, is a set of co-ordinating instructions which science has scarcely if at all begun to glimpse, and arguably cannot. It is, according to Sheldrake, a

morphogenic field - a formative influence which pre-exists outside the physical universe. Sheldrake also ascribes reparative growth to morphogenic fields, *e.g.* regrowth of limbs by some animals after amputation. These fields seem to us wholly consistent with theism. We postulate that morphogenic fields are a means of God's action in biology - a means of creating, maintaining, & modifying species.

Sheldrake points out that the 'behaviour' of a TV set - the showing of homunculi on the screen - might well provoke one who had never seen such a thing to seek within the set those homunculi; but the search would reveal only components arranged to resonate with an electromagnetic field.

It may perhaps be not too loose to suggest that morphogenic fields are a means for God's formal causes (*e.g.* the 'frog plan') to get implemented in the physical world. I would like to suggest further that our formal causes (*e.g.* Babich's 'claret idea') get implemented as efficient causes by means which are essentially unknown but which may be some variety or analogue of morphogenic fields. How spirit moves matter is a question regarding not only divine action but also our immediate physiology.

The concept of morphogenic fields has stood for decades as the only serious idea on offer for biologists who ask what is, so to speak, immediately behind the biological phenomena of metabolic maps, nucleic acid sequences, neuron pulses, muscle contractions, etc. Today many if not most scientists assume that nothing behind the superficial is needed - having never heard of half of Aristotle's 4 categories of cause. This is the stance of such main proponents of scientism as Dawkins. We believe Sheldrake has made good progress on integration of all 4 causes toward a more comprehensive theory of biology.

A decade after his original formulation of his secondary concept, **morphic resonance**, the empirical evidence for it summarised in Sheldrake's most recent book on his theory[11] was still slight. The concept, evidently difficult to demonstrate, is that a given efficient cause becomes more likely to happen after it has occurred once, *e.g.* crystallisation of a novel organic chemical, because the earlier occurrences modify the relevant morphogenic field. The dearth of evidence does not prove that morphic resonance is unreal; it may just be inconveniently rare for controlled, systematically repeatable observation. The Flynn effect[12] - the startling improvement in IQ test performances over a few decades - may well be an example of morphic resonance.

This postulated change-mechanism is to the fields themselves roughly as mutation is to routine accurate heredity. In each process the

secondary phenomenon is much less readily observed even if provoked (*e.g.* by an artificial mutagen, in the case of mutations) let alone at minimal rates (*e.g.* caused by natural radiation or minimal irreducible error rates in DNA replication).

Sheldrake assumes, for simplicity, that morphogenic fields are not attenuated in time or space. This does seem a convenient provisional axiom, but refinements will presumably follow. As for numbers, the exposure[13] of the 'hundredth monkey' myth as wishful thinking still leaves almost all relevant possibilities open. The power of groupthink, let alone prayer, is difficult to assess scientifically - but not therefore unreal.

Our main contention is that evolution cannot be explained by only material and efficient causes. They are necessary but not sufficient for the task. The chemical materials are necessary, as are the elaboratings of metabolic pathways within organisms and ecochemical cycles amongst them. But the patterns of evolution cannot have been produced by the mere outworkings of the laws of physics & chemistry. Ecological order, the grandest mechanism, implies design and therefore final cause. Consciousness is if anything even more glaringly not explained by mere efficient causes in biochemistry & biophysics[14].

We therefore return to Morton's exposition of the Four Causes: if the final cause - the person Babich - is required to explain the bottle of claret, mustn't we conclude that the living world is caused (in mysterious ways) by God's creative actions according to His plan? The efficient causes of organisms, seen in the record of evolution, require for explanation *the* final cause - God - working out his formal causes. (I recommend here, in passing, reflection on 'the Alpha and the Omega'; *e.g.* in The Millennium will formal cause have merged with efficient cause?).

I now proceed to interpret my original discipline, Biochemistry, on the understanding I just outlined.

A scientist contemplating any living organism can ask three types of question which may be vernacularly put:-

What's In There?

What's It Doing In There?

How Does It Know What to Do In There?

These three questions - historically, tackled in that order (with overlaps in time) - correspond respectively to Aristotle's material, efficient, and final causes.

1 'What's In There?'

The list of biochemicals, the material constituents of organisms, includes many minerals in various chemical states, but most famously compounds of the element carbon.

Scientists call compounds of carbon 'organic', and the branch of chemistry analysing & synthesising carbon compounds is called organic chemistry. Millions of organic compounds are theoretically possible, and about one million are known, most of them not believed to occur naturally. No other element than carbon exhibits anything like this complexity in its chemistry. Vague talk of alternative biochemistry based on silicon is low-grade science fiction. Biochemistry is aqueous organic chemistry.

Until the early 19th c. - well into the age of 'Enlightenment' - chemists generally accepted that, while organic compounds such as indigo were susceptible of analysis to discover their molecular structures, artificial synthesis of an organic compound was subject to a subtle quasi-religious aura of impossibility or, at least, peculiar extreme difficulties. By the first artificial test-tube synthesis of an organic compound Wöhler in 1828 broke down the mystique. He made urea, an organic compound having a simple 8-atom molecule, identical to the main nitrogenous organic component of the urine from many types of animal. Synthetic organic chemistry then flourished magnificently, earning many Nobel prizes; and today even modified genes get synthesised in the lab (but only with the crucial selective catalyses of enzymes biosynthesised by, and then separated from, living organisms).

There certainly are further biochemicals to be discovered, but by the early 20th c. the catalogue was beginning - rather like pieces of a jigsaw puzzle - to make enough sense to allow asking the next question.

2 'What's It Doing In There?'

Some sketchy list of biochemicals having been compiled in the heroic age of 'natural product' organic chemistry, it became practicable to begin the search for metabolic pathways - the network of chemical reactions which build up (anabolism) and break down (catabolism) biochemicals within living cells.

Another category of what's 'doing' in living organisms is electrical processes, notably in nerves. These are conventionally assumed to be reducible to biochemistry. Genes are assumed to encode the full instructions for macromolecules, importantly proteins but also nucleic acids (RNA & DNA), and bioelectricity is assumed to be caused by the cooperating behaviour of some of these macromolecules along with lipids

(fatty compounds) and some carbohydrates, in membranes. Similarly analysed are other transductions *e.g.* of chemical energy to mechanical energy in muscles. The discipline of physiology deals with these electrical and mechanical aspects of life, but the assumption is prevalent that those phenomena can be reduced to biochemistry.

By the mid-1960s J D Watson could advance (in the first edition of his textbook *Molecular Biology of the Gene*) some loose arguments that perhaps one-third of the metabolic pathways were known, for one species - a favourite subject of biochemists, the paradigmatic simple single-celled bacterium *Escherichia coli*. A vague feeling of quasi-completeness set in, at least for this and a few other relatively well-studied microbes. No longer did many biochemistry laboratories pursue discovery of further metabolic pathways; biochemists pressed on to the third category of biochemical question.

3 'How Does It Know What to Do In There?'

It is all very well to have a reasonably coherent picture of metabolic pathways - some idea of 'what's doing in there' - but how is this complex co-ordinated system unfolded as a frog zygote develops into a frog rather than a dog? This, the problem of development, had stimulated classical biologists to remarkable discoveries in embryology. The pattern of an organism's development as simply displayed within that species' life cycle had been investigated in some detail in a wide range of species. Restorative potentials were explored after various experimental ablations of anatomical or chemical parts. Patterns of biochemical coordination in time & space were explored in molecular detail, *e.g.* the biosynthesis of chlorophyll as a plant first meets light, or the biosynthesis of haemoglobin in mammalian cells specialised to produce this iron complex.

Development has been theorised as the successive expression of genes. The standard model has depicted the gene - in a cell nucleus or mitochondrion or chloroplast or plasmid or virus - as a stretch of DNA (or in some viruses RNA) constituting the linearly-encoded specifications to guide the synthesis of corresponding RNA, translated in most cases into corresponding protein molecules. Since the thousands of enzymes acting to catalyse their respective reactions within the metabolic pathways[15] are proteins, the general model emerges that development is largely a matter of synthesising, at suitable places & times, the appropriate amounts of the proteins - more generally, the macromolecules - which function in timely coordination to cause the dynamic network of chemical, electrical & mechanical processes occurring in living organisms.

Our first question asked for a static list. The second question was in essence dynamical - what *processes* occur in life? The third question not only asks about changing rates of biochemical reactions but also leads us to distinguish the different kinds of causes operating in biology.

If to explain a bottle of claret requires a final cause, how can a frog be assumed not to have been designed?

Biochemistry & physiology fall entirely within the categories of material and efficient causes. Regarding ontogeny, and perhaps even more strongly regarding phylogeny, such explanations - no matter how complete in themselves - should not be deemed to constitute between them, total explanation in biology.

The assumption to omit final cause in biological theory has been little discussed. This assumption is a most important aspect of the popular attitude **scientific atheism**. But is it better than mere question-begging? I conspue its furtive role as an unstated axiom of many modern scientists. It is usually just a thinly-disguised assertion of atheism.

Here is the comment of a prominent (USA) intellectual regarding our basic argument.

> My hunch is that complexity among organisms will gradually become understandable within a broadly Darwinian framework, just as Dawkins has proposed. It's always a mistake, I believe, to take the still-unsolved puzzles of the natural world as evidence that they require a creator; this has been disproved at every juncture, and I'm pretty sure the process of secularizing nature's mysteries will continue.

But do the laws of chemistry show much sign of explaining why the frog appeared in evolution? Is there even a glimpse of neo-Darwinian explanation why the type of algae known as diatoms do not appear in the fossil record until so recently as ca.150M year ago whereas the first algae were ca.3600M year ago? Can neo-Darwinism get far at all in explaining even simple organs in anatomy, let alone ecological behaviour such as migrations of eels or godwits? Sheldrake has argued that the popularisation of neo-Darwinist theory has amounted to little better than the issuing of an endless series of promissory notes. The actual achievements of scientific atheism in explaining life remain extremely slender.

It is not just that scientific atheism has made slower progress than it had hoped - though this sluggishness might be widely admitted. The inadequacy of explanation is not merely quantitative. The more

important point is the qualitative distinction: no amount of explanation in the categories of material & efficient causes can suffice to explain life.

Biochemistry & physiology are rightly pursued on the working hypothesis that their discoveries will establish more & more facts in the categories of material & efficient causes; but non-existence of final cause is a working assumption for the purposes of scientific method, rather than a general philosophical axiom let alone a fact of biology.

Absence of final cause has been a most regrettable - crippling, I would argue - assumption in much recent philosophy of science, and in the actual teaching of science to students. This error has been an unadmitted ideological projection onto nature, much like the 'red in tooth & claw' canard - the idea that competition rather than co-operation is the main characteristic of ecosystems - which has been (as Goldsmith has argued in his magnum opus 'The Way') projected onto biology from the ideology known as economics.

I think what has essentially been going on since Darwin and Wallace presented their main idea is misuse of that idea as a weapon for atheists to club religion. The pretence that science can supplant religion, rather than cooperating with it, has been far too influential and should be promptly abandoned. The status of scientist confers no special authority in theology or even epistemology. Omitting half of the 4 causes is an axiom acquiring no valid augmentation of authority from Dawkins, Weinberg, Hawking, or any other scientist.

The end of 'creationism'

Morton brought up to date the 4 causes. We can now see that evolution, as a material process, is an array of efficient causes which cannot bear directly on the question of final causes (though it does give hints, explored in natural theology).

To admit evolution as a fact is not at all to deny creation but only to say that it has been more or less continuous. For a theist, as opposed to a deist, the concept of God's constant creative participation in the world is essential; the idea that novel species ceased to be created after the 6th day is more in the nature of deism and can hardly be claimed to give God more credit or respect.

The big bang and the subsequent workings of the laws of physics & chemistry - a dazzling set of efficient causes of the world we now live in - hardly begin to explain **why** organisms came into existence, or why they so marvellously cooperate in ecosystems.

The real issue is not the mischievous waste of time misleadingly called "creation science" which diverts thought into the phoney dispute

'evolution *v.* creation'[16]. The real issue is realistic explanation *v.* invalid neglect of final cause.

—-

Dr Don Nield: Again I have no question but a comment. I think Drs Broom & Mann should perhaps be a little more careful in their terminology in talking about neo-Darwinism. Both speakers introduced the idea quite correctly - it is just the combination of genetics, especially as developed 1920-50, with the natural selection proposed by Darwin. But in fact many of those who developed neo-Darwinism were Christians. Shouldn't we distinguish neo-Darwinism from Dawkinsism?

Mann: That's a fruitful suggestion - any contemptuous focussing on Dawkins is very welcome to me [laughter]. He's a disgrace to science [laughter]. I'm glad you can laugh at that - I can't. I'm worried when science is disgraced to the extent of his selling millions of books. There's something very wrong with the public status of science when that kind of rubbish can sell to that extent. Sheldrake, by contrast, is in a different class - he's getting down to business; he's acknowledging all 4 causes, whereas Dawkins (while of course not being so helpful as to say so) is flagging away 2 of the 4 causes. It's a travesty - a shocking piece of slum-dwelling in the history of intellectual activity.

Q. In the new age of quantum technology, when we find that time itself is a variable, might we not find in the future when the blinkers are taken from our eyes, maybe the Six Day notion is still on because Time itself changes in length? We all know that the atomic clock that goes from here to the moon & back runs slower than the one that stays on Earth.

Mann: I don't think that will get you very far at all in explaining the difference between 6 days and 6 billion years. The apparent variation in time to which you allude is not really cogent to anything I've discussed today. And here let me mention that the Heisenberg Uncertainty Principle which is intimately tied up with the realm of thinking you've referred to shows very little promise indeed regarding any of the questions I've touched on. It's essentially blind; it gives no hint of final or formal cause; it's just a source of randomness, which is *not* what we need to explain evolution.

Finlay: I see efficient and material causes as being rightly the subject matter of science. Final and formal causes are personal categories and therefore cannot ever be suitable for scientific investigation.

Mann: Yes!

Finlay: So it's not that formal & final causes can ever be biology; but the question is whether we add by faith personal causes to our biology or do we dismiss personal causes from our biology. The biology itself is the same.

Mann: Yes I think that's a very reasonable approach. Of course, it's always tempting to say the province of religion doesn't overlap with the province of science and therefore they can't come into conflict (let alone war according to A. D. White). There is some truth in that line, but it won't quite do; they do in fact overlap, and indeed we *want* them to overlap. We want a new biology to stop being so fixated by materialism and to explore seriously, as Sheldrake has led us to do, how biology could at last get interested anew in how final and formal causes are to be understood as affecting life. I don't want any more materialistic biology; I've pointed to main thinkers who are giving us some leads for re-integrating strictly 'scientific' biology with a much wider view. I commend especially Professor Morton's paper in the Festschrift which will give you more leadership than you've yet seen.

—-

[1] John Morton *Man, Science and God* pp.13-17 Auckland & London: Collins 1972

[2] *e.g.* Descartes to Mersenne 1632 "I expect soon to be able to calculate the position of every star"

[3] L Margulis & K V Schwartz *Five Kingdoms* Freeman 1998

[4] (compiled in collaboration with Mr Art Haughey and Assoc. Prof. Jack Grant-Mackie)

[5] N D Broom *Ecologist 28* (1) 23-28 (1998); much more detail in *idem* 'How Blind is The Watchmaker?' Aldershot: Ashgate 1998; revised ppbk edn. Downers Grove: IVP 2001

[6] M E J Taylor *Greek Philosophy - an introduction* pp.120-121 London: Humphrey Milford, Oxford University Press 1924

[7] A Flew *Introduction to Western Philosophy* p.159 London: Thames & Hudson 1989

[8] (but note that a person who tries to patent a transgenic organism is claiming to be a final cause)

[9] It is possible to imagine reasons why Sheldrake normally inserts another syllable: morphogenetic.
[10] C H Waddington *Towards a Theoretical Biology* 2 vols Edinburgh Univ. Press 1969
[11] R Sheldrake *The Rebirth of Nature* pp.88-90 Century 1990
[12] J R Flynn, 'Massive IQ gains in 14 nations: what IQ tests really measure' *Psych. Bull. 101* 171-191 1980
[13] Markus Possel & Ron Amundson 'Senior Researcher Comments on the Hundredth Monkey Phenomenon in Japan', *Skeptical Inquirer*, May/ June 1996.
[14] I remark here that Heisenberg uncertainty is very unpromising as a source of free will, much as random mutation is a most unpromising source of order in ecology.
[15] 'Biochemical Pathways' wall-chart Mannheim: Boehringer Chemicals semi-annual
[16] Robert Mann & Neil Broom 'Creationism *v*. evolution but not creation *v*. evolution' *Stimulus 8* (2) 16 - 21 (2000)

The Word and The Process

Science and Philosophy in an Evolving Biosphere

John E. Morton

Presented to the festschrift resulting from the symposium 'Science and Christianity', Auckland 01-4-21.

There is a stubborn integrity of science (can we even call it an ethic?) that will accept Mistress Quickly's words of comfort to the dying Falstaff not to be thinking of God - "there was no need to be troubling himself with any such thoughts yet". It is such advice that has too often brought a battle between evolutionists and theologians - in fact needless, but still flaring up, or kept at bay only by what John Habgood (biologist & archbishop) called "the uneasy truce".

Someone recently remarked that the trouble with the "creationists" is that they just don't get the point - they can't distinguish between the necessary methodological materialism of science and a philosophical materialism.

The things we know best about Biology are the furthest removed from the highly abstract laws of physics and chemistry. It is from our own data of experience that we can learn something about other organisms like ourselves. Words like **adaptation**, **regulation** and **co-ordination** derive their meaning from our experience as personal beings. We know of the aliveness of life, not out of empiric observation, not even by induction, but in a way we could justly call 'shared feeling'. The proper word could even be 'sympathy'.

The complexities of a living world, while they harness physical laws, are not reducible to them. Each higher level has its proper rationale. Nor do we even find a graded transition from one level to a new one. When things get complicated enough they are seen to take on a life of their own.

The philosopher of biology Michael Polanyi found it "almost empty of meaning" for physical matter to be the ground of life and purpose. Uni-

versal knowledge of all things reduced to the laws of physics would tell us hardly anything interesting about the world.

The hierarchy of causation thus becomes less and less specific - and hence less informative. It is true that biology can be worked from either end - by analysis or synthesis. Indeed a fundamental division of human temperament & thought runs through biology itself. But biology's special responsibilty is not to pursue reduction down to atomicity. Its prime interest is productive and progressive: entrained on the building-up by life of novel and more complex systems.

A Paradigm In Trouble

Richard Strohman, *Nat. Biotech. 15* 194-200 (1997), has predicted what has been called a Kuhnian Revolution in the philosophy of science. A reigning paradigm (or explanatory model) sooner or later can develop anomalies. It produces errors until it falls under its own weight, to be displaced by a successor waiting ready in the wings. It is the paradigm of the GENOME that Strohman finds in trouble today. He finds its failure in the mistaken idea that complex form and function and behaviour may be traced solely to genes and their product proteins.

I can remember so well seeing - as a student - the brief letters in *Nature* in l953, where Francis Crick & James Watson announced a double-helix structure for 2-strand DNA. Such was its clarity and seeming explanatory power that the genetic alphabet was early brought into Stage I courses. Given such a coding the whole history of life - many were quick to accept - had been stored and transmitted. Molecular determinism was soon to be raised into the central pillar of biological science.

This high assumption is being increasingly questioned today. Richard Strohman saw the theory of the gene as

> "beautiful and magnificent in its utter simplicity. A child could understand it, and millions of children now do. But if you mistakenly ask them what it means in terms of function you have shamed them."

In fact - he claims - it has explained two things:

> "TRANSCRIPTION where DNA sequences become protein forerunners in the form of messenger RNA ; and TRANSLATION,

where the linear sequenced messages in RNA are converted to linear sequences of amino-acids in proteins . . . . End of story."

Yet, from fifty years of popular currency, genetic determinism still has great persuasive power. The gene industry is now a hugely-resourced world-wide trade commanding the major share of our research funding in the life sciences.

Teleology, with the intuition of **final causes**, has been deprived of all explanatory power. The whole theorem of Darwinism is to be retold digitally from the blind struggle for survival. The bodies of organisms, including our own, are in their intricacy and beauty of adaptation the throw-away containers of the "Selfish Genes". We cannot expect to understand why, for there exist no ulterior explanations; Richard Dawkins assures us "DNA just is . . . and we dance to its music".

The critics of this view would hold that the highest claim tenable for the genes is to see them as *instrumental*. They do not carry form or give instructions. Rather do they offer ingredients. They would thus operate at the lowest rank of causation - as material causes.

The first disability of the genes as an instruction-code must be their identity in almost every cell of the organism. There is no selective allocation. Every cell gets everything. It is as if there was a bare ceiling with all the pigments available at every point. To paint the pictures in the Sistine Chapel would involve information from somewhere else. So recourse was suggested to a second order of *control* genes, supposed to manage the structural or primary genes by specifying their dosage over a complex of space/time gradients. But such master genes would still in turn be part of a uniform genome - and powerless to differentiate a particular form.

So the next higher level has been in its turn invoked, called *epigenetic*. It would involve a whole complex of interactions, with open networking of l00 or more genes (by analogy with neurones), proteins and environmental signals. Far beyond the genome we have reached the largeness of the organism itself.

There are still some physiological cases where a unit gene might be said to equate to a finished character. These monogenic conditions are the main subject of current genetic "engineering". Such are the genes not of

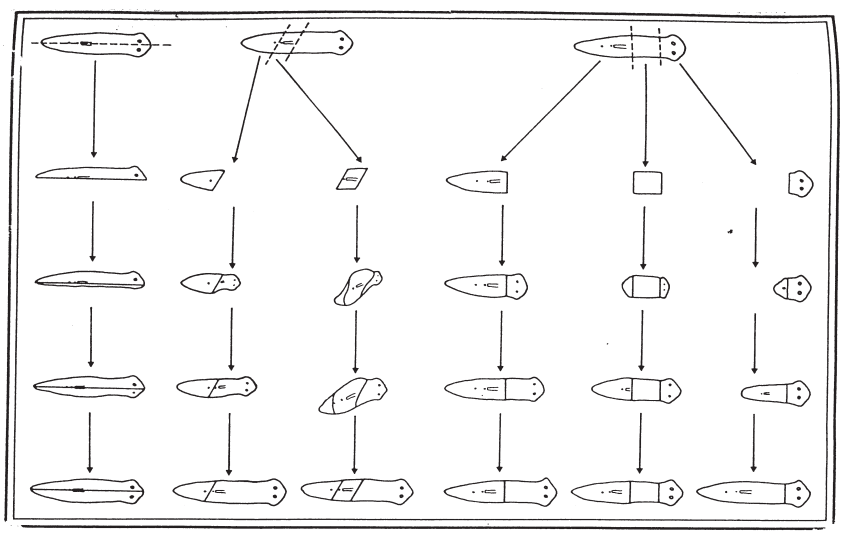
constitution but of condition. They may control size or colour or provide or suppress some critical enzyme. Thus in monogenic diseases such as haemophilia or muscular dystrophy or cystic fibrosis a single allele is crucial.

"The Presence of The Past"

Here then is the outstanding fact of biology, the high fidelity to the past that every organism shows when it replicates itself in reproduction, or makes repairs by regeneration, or merely maintains its being in homoeostasis. It is the real source of such species-memory as we must now go on to pursue.

A Field Effect?

We are are thus brought from the genome, through its epigenetic environment, to the involvement of the whole organism. In a classic experiment in the l870's, Driesch cut in half a sea urchin embryo at the 2-celled stage. Each resultant cell was found to produce not a half-larva but a whole one.



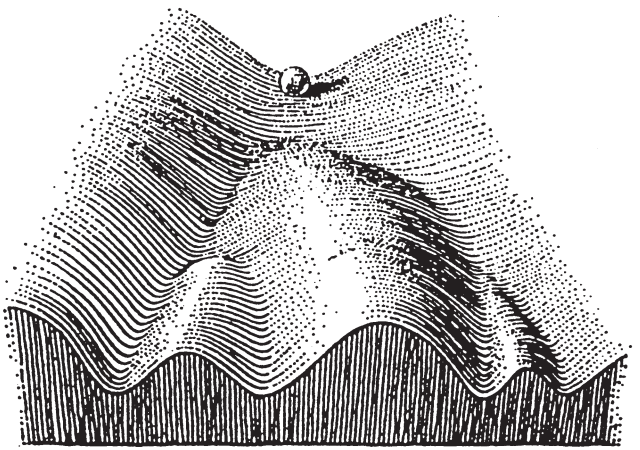
REGENERATION OF A PLANARIAN FLATWORM

Whatever the regulative principle, such a word as **vitalism** comes to be provisionally applied, without further spatial analysis, to the production of a whole morphic pattern. Similarly, after macerating a small vase-shaped sponge, we can find the fragment cells restoring their arrangement in orderly tissue layers, just as in a butterfly the complete breakdown of

the larva to a cell-soup is followed by faithful reconstitution - organ by organ - in the pupa. Or we may slice up the flatworm *Planaria* in whatever direction, and find each piece regenerating to a complete worm.

An Epigenetic Landscape

In the l940's embryology was dominated for us as students by the powerful book of Richard Paul Weiss, 'The Principles of Development'. We had been led to the supposition of fields by which regeneration or normal development is marked out. Carl Waddington called these fields 'epigenetic landscapes', and one of his early books had an aerial photograph of a vast railway marshalling yard, with repeated branching & subdivision out to the ultimate sidings. Thus, by ever-narrowing and more specific individuation, each separate structure or organ took its proper line, to its final site & form. Waddington's finished landscape consisted of channels or **chreodes**, down which an organ primordium could roll to its destiny. But all this was accepted as no more than a descriptive model of what in fact happens. Developmental fields had no explanatory or causative role.



Faith in Chemistry?

Patterns within the field were in the l930s increasingly supposed to be evoked by a chemical organiser. Thought to be a complex steroid (in the frog or newt located in the dorsal lip of the blastopore), this substance was seen as a "first mover" in releasing wholly unexplained differentiation effects. A foreign dorsal lip, transferred to another part of the germ, could moreover induce a second embryo. But there was no success in identifying the supposed organiser substance. Other stimulants

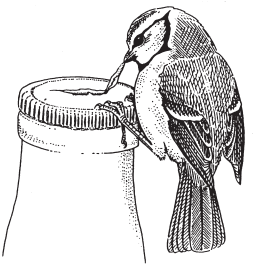
such as methylene blue (even - it was irreverently suggested - cheese or a bit of bus ticket) could produce similar effects. Chaos enveloped the notion that chemicals can somehow produce things.
A generation later - in the '60s - it was not only things but even "thoughts". A systemic mutation of the RNA in the wrappings of the neurones was held to write-in each novel item of experience, thereafter to be held available for read-out as conscious or subconscious memory. Ambitious projects were set up, such as for feeding naive flatworms with RNA from instructed individuals. This could have been like teaching theology by putting the missionary in the cooking pot. Better indeed, it had been satirised 200 years before its day by Swift, in Gulliver's visit to the scientific academy at Lagado.

FROM "GULLIVER'S TRAVELS"

I was at the mathematical school, where the master taught his pupils after a method scarce imaginable to us in Europe. The proposition and demonstration were fairly written on a thin wafer, with ink composed of a cephalic tincture. This the student was to swallow upon a fasting stomach, and for three days following eat nothing but bread and water. As the wafer digested, the tincture mounted to his brain, bearing the proposition along with it. But the success had not hitherto been great, partly because the pupils had not yet been persuaded to go so long without proper food.

Morphic Resonance
Into this still mysterious scene was to come RUPERT SHELDRAKE of

Cambridge, with the most revolutionary and - I believe - liberating proposal in biology since Darwin. In 'A New Science of Life' (l98l) Sheldrake ascribed the role of instruction to resonant **morphic fields**. These are held to be objectively real, and to have a commanding role of formative causation in laying down the course of development. Though causative, such fields are not however like Plato's ideal forms eternal and invariant. For every species they are constantly subject to change, by picking up their complex resonance patterns sent back to them by the myriad oscillations of all the currently living individuals.

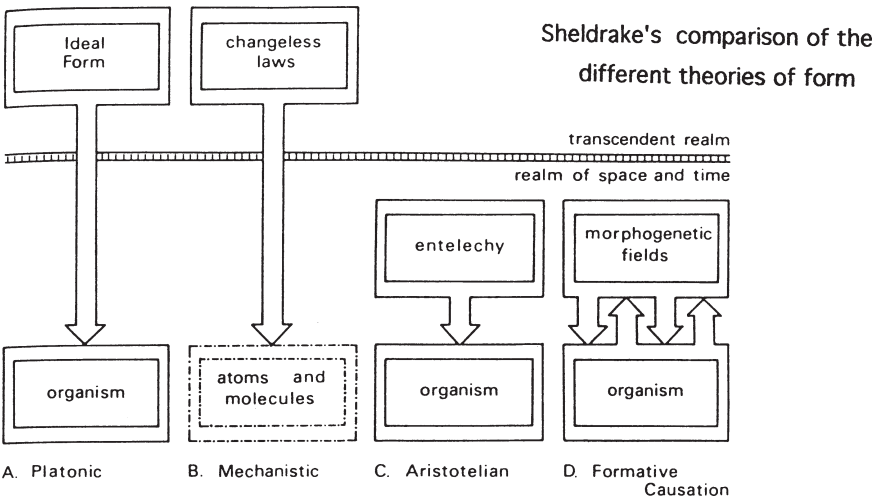


THE BLUE TIT

A now famous example, with its rapid spread attributable to morphic resonance is the novel milk-bottle behaviour acquired by the blue tit. These birds learned to pierce the metal-foil tops of bottles to reach layer of cream...First noticed in Britain at Southampton in l92l the habit spread to Scandinavia and the Netherlands in the 30's, even though individual birds never move more than a few miles from their breeding place. Milk bottles disappeared in the Netherlands with the war in l940, being restored only in l947-8. Though no pre-war birds could have survived, yet the habit reappeared at once, and in several widely distant places, with numerous individuals involved from the outset. It was soon widespread.

So **morphic resonance** is claimed to involve a non-energetic transfer of information on the basis of rhythmic patterns of activity. All organisms manifest such rhythms, from the activity of electrons, atoms and molecules, to the rhythms of heartbeat, muscles and nerve cells. For each of these levels, the fields are nested in others of wider import.

Action is thus two-way. The field is itself set up by the resonance received and the species is kept in being (instructed and informed) by what is sent back. In its patterned complexity the morphic field is not individually deterministic, but is probabilistic, something like a mass identikit picture. In its quantum uncertainty it thus allows a significant measure of freedom in the organism's response.



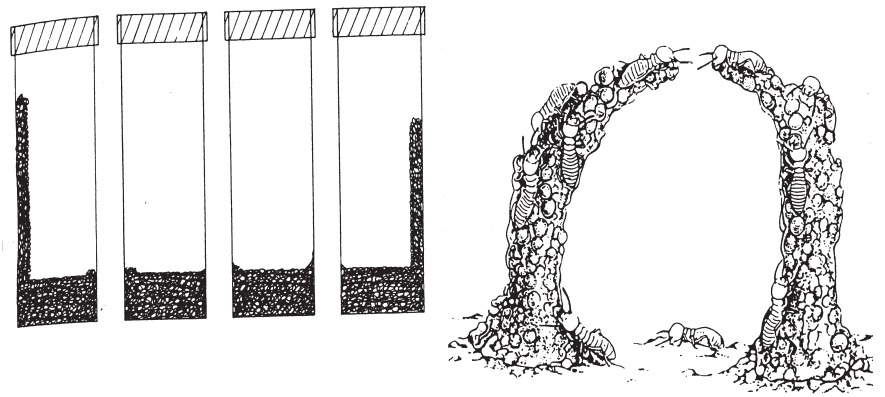
SHELDRAKE'S COMPARISON OF THE DIFFERENT THEORIES OF FORM
The Platonic theory has a one-way influence from the transcendent form to the organism. In the mechanistic theory there is a comparable one-way influence of the transcendent laws of nature on the atoms & molecules that make up the organism. In the Aristotelian theory however the organising entelechies are immanent within the organism and around it, rather than transcendent. In this way they resemble morphic fields.
However - maintains Sheldrake - entelechies like Platonic forms and transcendent laws, are fixed in nature and cannot evolve. They would not be affected by what actually happens in successive generations of organisms. By contrast, according to the hypothesis of formative causation, morphogenic fields are affected by what happens within organisms, and contain an inherent memory. They are evolutionary in nature.

Morphic resonance is held to occur between rhythmic activities on the basis of similarity. Past activity can thus continue, without any necessary decrement through distance or time, to influence the present. The sector being influenced is said to become buried within the species field. It is thus to be seen embedded in the chreodes or channels in the developmental landscape that lay out the course and flow of development.

Morphic fields are not then seen as metaphysical entities but as something empirically real, in the same sense as gravitational, electromagnetic, and nuclear-force quantum fields. What is new is that they are neither tightly determined by transcendent ideas nor describable by mathematical formulae. Though clustered with other fields of higher or lower degree, each species field is constituted under the influence of all the individuals past & present. Through its available resonance, and

being constantly subject to change, the field in turn sets the form of further generations.

If such fields were to operate in the mode of Platonic ideas or forms, they would in contrast have only a unidirectional causative influence. The actual forms of the existent organisms could exert no counter-influence upon the information systems. Platonic influences would remain changeless in their transcendence over physical reality. The invariant forms created by them would thus be permanently present everywhere.



Construction of vertical galleries by termites Heterotermes kept in plastic containers with building material. All chambers contained equal numbers of termites. Gallery building was suppressed on the walls adjacent to other containers. This influence passing from container to container was mediated by fields.

Recognition & Tuning

Under the hypothesis of formative causation, organisms inherit not only their genes but their morphic resonance. Genes would have their essential role not in pattern forming, but in providing ingredients, as might tubes of artist's paints for a picture, or a load of bricks to be turned into a house. The genes' function is to produce the needed proteins, whether catalysts or structure-builders. They provide - as we have emphasised - the ingredients. But the determinative instructions are to be held the task of morphic resonance.

Sheldrake has memorably compared the genes to the electronic components of a television set. Neither contain form-information; both receive it from the world outside.

> "Changes such as a fault in a transistor can alter or abolish the pictures on the screen. But this does not prove that the pictures arise from the components, nor that they are programmed within the set. Likewise the fact that genetic mutations can affect the form and behaviour of organisms does not prove that form and behaviour are coded in genes or programmed genetically. Form and behaviour do not arise simply from mechanistic interactions within the organism, or between the organism and its circumstances; they also depend on the fields to which the organism is tuned."

How then does a developing germ become tuned to its instructing field or hitched to its star? Tuning must initially depend on the presence of appropriate genes and proteins that will recognise a salient part of the morphic field of their own species. A frog's egg thus tunes into frog rather than newt or goldfish or chicken fields because it is already a frog cell containing frog genes and proteins.

Chemical alterations in the genes could result in distortions to the normal process of development, just as interference with the components of a TV set can lead to aberrations of the picture. Some mutations could affect the normal development of the germ in quite small ways. Then there are those other gene changes (homoeotic mutations) that can entirely suppress an organ or a process, or even replace it with an alternative, as if the set were now picking up a different channel.

"Chance & Necessity"

These were the words of Jacques Monod's presentment of Neo-Darwinism with natural selection. Evolution happened with chance mutations of the genes which were held to be the sole source of heritable change. They appear entirely at random. Statistically they could be looked on as wanderings or "error". They bear no necessary rapport with the organism's needs. Most are indeed disadvantageous, some even lethal.

Such rationality as evolution may achieve is supposed then to have been salvaged from the wells of Chance by the principle of Necessity. It is this that has been called Natural Selection, resulting in the so-called Survival of the Fittest, and held by the neo-Darwinists to be the sole motor of creative advance.

Yet there is the big difficulty that what would be the fittest for the future of the race need have little relation with what - in a present or short-term exigency - has been found to survive. No *a priori* criterion of fitness is available to determine the outcome. The "fittest" is thus no more than a tautology for that which in fact survives. The only Necessity is that "something" will.

We would so have a planless world - or a world in which mere survival is the surrogate for any plan. Survival of the fittest, with its fellow doctrine of Social Darwinism, is in turn the model for a *laissez faire* economy where we can never know what future we are making until that future has arrived.

Or if the future of things could be in some part predictable, this would only be because of the narrowing of the viable options in light of past happenings. Called *orthogenesis* , this would lead to safe-playing rather than creative advance. For Natural Selection can create nothing. Unlike gene mutation or crossing over, or even genetic drift, its only role can be to reduce variance.

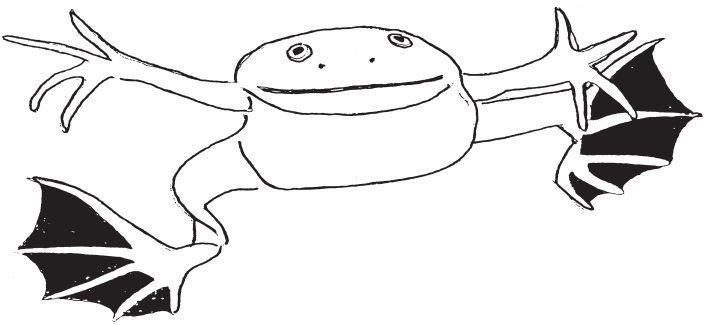
Behaviour Leads The Way

Instant structural change is hardly imaginable. The organism's first response must thus come through behaviour. The capacity for such response must greatly vary with species and circumstance. Yet behavioural flexibility must always be enough for the individual to be in a significant sense 'free', in whatever degree it may however fall short of conscious reflexion.

Behavioural change could in turn be expected to have early effects on structure. New bodily forms could be founded on changing habits. Evolution would thus come as *the origin of habits* , with behaviour primary, and all else following in its wake. To Darwin a structure meant a habit, and a habit implied not only an internal need but also outside forces to which the successful organism must accommodate.

For one example out of multitudes, we may look at the frog's foot. Though close to those four-legged amphibians that took the first steps on land, frogs and toads never seriously exploited the new-evolved foot for walking. Instead, the hind limbs became specialised for leaping, and in *Xenopus*, the horned toad of southern Africa, the legs were used for

swimming. With wide splaying of the toes and repeated thrusts of the foot against water, folds of skin between the digits would have begun to enlarge and strengthen as webs. Nothing is at first hereditary: simply what has long been called an "acquired character". This is a modification derived from function. Sometimes a change of function can lead to reduction or loss of a structure; but our frog gives an example of "use-hypertrophy": an organ growing larger with intensified function.



The frog/toad foot can provide a host of other structural adaptations, all evidently initiated in behaviour. Tree frogs (Hylidae) can climb, with the digits flexed for grasping. As well they can expand the tips of the toes to develop suction discs. There are even arboreal flying frogs, gliding between branches on broad webs of hand and foot.

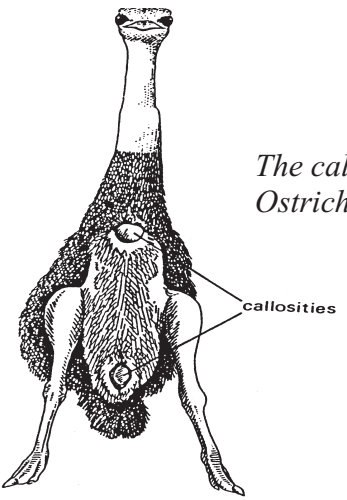
Function Prescribing Form

Some of the best-documented translations of stress into structure can be seen in the realm of orthopaedics. The trabeculae of hard bones are related to directions of compression & tension in the same way as an engineer reinforces concrete girders. Structure is matched to the lines of force, according to the rules of bone growth operating in life.

Function can so be seen determining form - not just episodically, but regularly and meticulously throughout life. It points up a truism that every structure is not only inherited but must also be in every generation acquired.

Yet all the teaching we grew up with as students assured us that modifications arising from function could have no evolutionary relevance, because they were not represented in the hereditary genes. Thus - however difficult to believe - the inherited horny calluses developed on the chest

and pelvis of the ostrich where it crouches on the sand happened to turn up independently of the fact that similar modifications can be induced by behaviour in life.



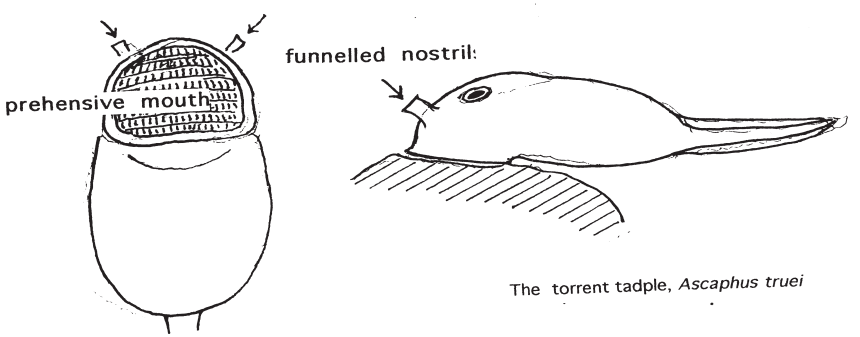
The callus pads of the Ostrich

Could it not be possible that signally useful modifications initiated with behaviour could themselves take on enduring evolutionary significance? The Darwinist answer was firmly No. Yet it seemed to me that even under the current orthodoxy there had to be more to it than this. For a new behaviour already operative and producing a structural modification (SM), would clearly improve the likelihood of selection of any genetic variation (GV) that might turn up with parallel or similar effects. Likewise any engagement of behaviour would from its inception provide a climate of selection value (SV). Such a common-sense postulate - although I did not know it - had half a century before been proposed and given a name. It was the Baldwin Effect, alternatively called Organic Selection, that had - in the misleading climate of Weismann - remained buried in literature from the turn of the 20th century.

It becomes a question whether the gene mutations - so long held sacrosanct as in a line of apostolic succession - really by their nature stand so fundamentally apart. The development of the ostrich's callus, the frog's foot webs and the bone's trabeculae, whether initiated by genes or behaviour, evidently involve the same histogenic process at the same site. Who is able to deny that they could be one and the same change, part of the organism's intrinsic proneness, though being delivered in different ways; and that if occasioned by modification, they can in the natural course - in Waddington's phrase - become genetically assimilated?

The Torrent Tadpole

Confident that something like this must be regularly happening, I used to invite my first students to consider another amphibian, the Canadian mountain frog *Ascaphus truei*. Its specialised tadpole lives in torrential streams, clinging to smooth stones by its much-widened mouth lined with file-like rows of teeth. Such attachment has very plausibly led to other structural changes. With the mouth pre-empted for a sucker, the nostrils have been converted into wide funnels to bring in food particles with the respiratory current. The body has at the same time become broad-based and streamlined to resist currents, while the dragging tail-fin is reduced.



The torrent tadple, *Ascaphus truei*

All these alterations - common sense would again suggest - could have been initiated and improved by constant behavioural use. While the need remained, the mouth could in each generation be expected to gape wider and cling tighter, with the nostrils further enlarging by water passage.

It was only in l965 that a zoologist of front rank, Sir Alister Hardy, came to recognise the Baldwin Effect with the weight it deserved. Natural selection was then seen to be operating in two ways:
(i) external (involving the physical and climatic environment, and the biotic effects of other animals and plants, as well as intraspecific competition with others of the same species); and
(ii) internal (involving the organism's inside milieu and - most importantly - the individual's own behaviour). For the internal effects Hardy revived the term *Organic Selection* , first used at the beginning of the century by Baldwin in America and Lloyd Morgan in England. Hardy's considered insights into behaviour and organic selection were presented in his Gifford Lectures and his classic book 'The Living Stream' (l965).

Organic selection could clearly be the way the organism makes structural

provision for an intrinsic thrust first manifested in its behaviour. Natural selection, though still - in the Darwinian mode - playing its important part, would now have to be seen as pruning or restraining a tree. The organism was itself responsible for its pattern and strategy. It could no longer be seen as just a matrix for the thrust or "insult" of an outside environment. Change must be at its own first initiative, through the resources of its morphotype and constitution. In the initiation of such change, the organism was to be held in a significant degree "free". Hardy thus summarised the careful reasoning presented in Morgan's 'Habit and Instinct':

> When organisms enter a new environment, those with somatic plasticity develop changes. Those without plasticity do not, and being unequal to the occasion are eliminated. This may happen generation after generation, with changes plastically acquired and not inherited. However, although there is no transmission of structural modifications (SM) to the germinal substance, congenital variations (CV) in the same direction would not be repressed but given full scope, tending to favour the individuals in which they occur. Any variations antagonistic to the modifications will tend to be thwarted, and render their possessors liable to elimination. Thus will arise a congenital disposition towards the modifications in question. The longer the process continues the more marked will be the predisposition and the greater the tendency of the congenital variations (CV) to conform in all respects with the structural modifications (SM). With plasticity continuing, the modifications will become still further adaptive, being genetically augmented while themselves giving compatible genes selective advantage.
>
> The process thus becomes circular, with plastic structural modification initiating and germinal variation following. The first paves the way for the second. Natural selection will foster variability in advantageous lines when this has been once initiated by behaviour with its induced modifications.

In the day-to-day working procedures of the geneticists - involving new engineering of the genome - few operational changes might in fact be necessary from our new understanding of the genes as ingredients. There might however be evolutionary changes, such as the acquired behaviour of blue tits with cream bottles, that do not initially involve gene changes at all but could be transmitted to and from the morphic field.

A generation before Sheldrake, Alister Hardy had courageously suggested a role for telepathic communication. It could in fact be only through a shared field understood in Sheldrake terms that a species does not become a dispersion of monads but maintains its real ontologic unity. Each developing germ would align to this unity, hitching to its guiding star by picking up the cues from the strategic recognition of shared proteins or genes.

Co-creative and Free

Sheldrake's 'Rebirth of Nature' was to restore to us a reminder of the freedom natural historians have long intuited life to possess. The living world is seen as innovating and adapting in the constant pursuit of goals. This goal-directedness must flow from life's defining property of perception of stimuli: entailing communication and behaviour consciously adaptive to aims and anticipations, as expressed in the philosopher's careful, yet understandable word 'intentional'. But for the vast majority of creatures, such problem-solving will not translate into reflective self-consciousness; nor shall we forget what a great proportion of human behaviour remains below that level.

Ideational consciousness of the self seems a human acquisition under the governance of the (major) left cerebral hemisphere. Still governed by the (minor) right hemisphere are all the complexities and directedness of something like a sub-conscious mind. It is evidently in human life alone that some of these operations are projected into consciousness, with the two hemispheres cross-connected by the great commissure of the corpus callosum and the smaller anterior commissure. But non-human life may still in effect be enjoying, inchoatively and non-reflectively, something like the goal-directed freedom of our own actions, and even volitions.

Recognition that behaviour leads the way, with function in advance of structure, could offer some reparative justice to Lamarck. For we find these same needs and drives of the organism expressed in Lamarck's *besoin*, however clumsily the critics had rendered the word as 'desires'.

Like Lamarck, Henri Bergson in 'L'Evolution Créatrice' (l9l3) saw living things as innovative and free. Life was striving to find its outlet, pitted against an inanimate environment that is all the time being broken through. Indeed the world's primary division runs between life and matter, and life's main-spring is Bergson's *élan vital*. Life is seen as unified, continuous, and only to be fully manifest by its flow with time.

Matter - to Bergson - was that into which the analytic intellect likes to carve up reality.

To Bergson, both Mechanism and Teleology imply that the future could conceivably be known in advance. Both would deny the possibility of real novelty. As distinct from either, Bergson saw life as essentially creative, like an artist's work. While the non-living world is driven by entropy under the second law of thermodynamics, life's special metier is the local reversal of entropy. Life is seen winding up in a total world that is slipping back: climbing towards ever more advanced levels of organisation; it may even be likened to sailors scaling up the rigging of a sinking ship.

The Mystery of the Given

With his theory of morphic fields, Rupert Sheldrake remained reticent about first origins. Yet he well recognised the central and ontological mystery: how any particular thing as unique and hence improbable as a frog or a foxglove should ever have happened. Thus, morphic fields that operate two-way - in novel uptake as well as continuing replication - pose new questions to which they must be looked to for answers. We ought not to be surprised or disconcerted if apprehension of morphic resonance, bringing us to fields of a quantum order, or even beyond, should prove unable to reach past apprehending to full comprehension in ourselves as creatures in its outcome.

Sheldrake's fields offer more than the descriptive epigenetic landscape of Waddington, or von Bertalanffy's promise of a General Systems Theory, or Brian Goodwin's supposition of mathematical laws of biological development that somehow replace traditional reliance on genes. These recourses are of no ultimate help, nor even of real interest. They are like calling up answers "from the vasty deep". The real doubt is whether they will do their work when called upon.
Just as unhelpful must be Prigogine's pictures of spiral waves appearing spontaneously by chemical action or stimulation with a hot needle. Complexifying form changes were here suggested to be generated by naturalistic means as material effects. But as Sheldrake emphasises, the appearance of some random "doodle" gives no assurance of the emergence of any definable or particular structure.

In all this the fundamental error must be to imagine that particular forms can be answerable to general laws for their existence and unique

character. Philosopher Gilbert Ryle (himself no friend of metaphysics) has given us stern warning that the laws of nature are not causes but only governing conditions:

> "Natural laws do not ordain everything that happens. Indeed they do not ordain anything that happens. Laws of nature are not fiats."

Particular forms are with us as part of the mysterious given. We sometimes use for them the term surds (with its connotation even of stupidity) to underline their ultimate irrationality. While the formula is rational, those peculiar constants stay mysterious. It is like having a valid syllogism, with the major premise demanding acceptance unexplained.

The Word and The Process

The argument pervading evolution is about God's original creativity against the creature's freedom of co-creativity, in response to its own nature and goals and under the pressure of environment. This battle has been left largely un-faced or avoided by scientists and metaphysicians in today's uneasy truce.

We need to look at two separate levels to which the evolutionist has given distinguishing names. The first to happen (though not the one we most familiarly see) would be the appearance with something like spontaneity of a novel morphotype or - as we'd now call it - a new morphic field. This - like a takeover bid - need not involve alterations of detail at the lower nested levels. It will be a matter of a new and over-arching pattern embracing and pressing into use older ones at the levels beneath. What is going to change is not the working conditions bench by bench but the higher policy and management levels. As Sheldrake writes,

> "new patterns include old ones within themselves. Nevertheless they are new and come into being suddenly. They have a wholeness and integrity that do not admit of gradual appearance. The fields are wholes and precisely because of their irreducible integrity they have to appear suddenly".

This is the kind of change that is called *anagenesis*, recognising it as the basis of periodic but continuing advance. Though it occurs everywhere, from plant life history to the separate phyla of animals, it may be

exemplified most confidently in the progress within the "anthropic" vertebrates leading up from fishes to humans.

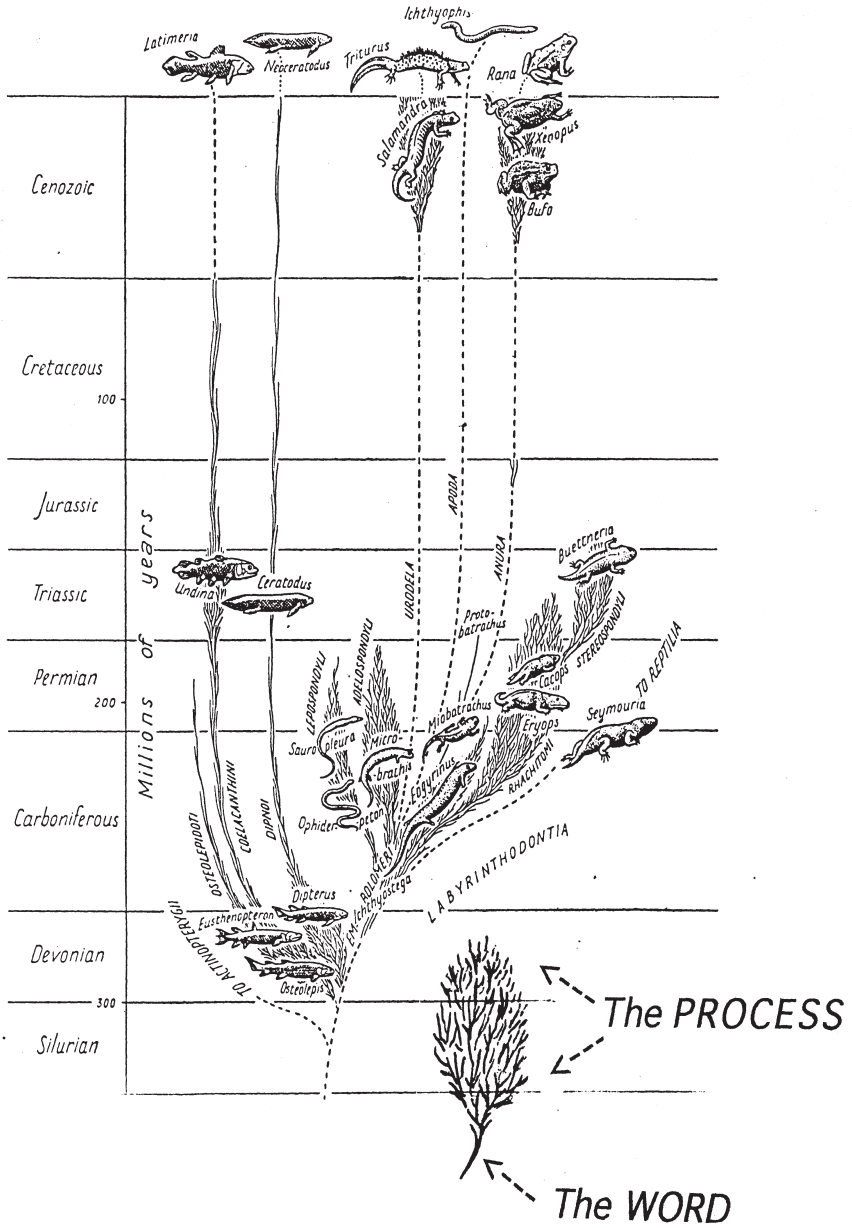
The second and smaller, but by far the more familiar and continuous, mode of evolution is what we call *cladogenesis*. It concerns not fundamental change but - as the name suggests - shorter and repetitive branching, in the nature of adaptation and radiation within the same morphotype. The old notion of a morphotype goes back to the beginning of the l9th c., before evolution was properly understood, to the botanist de Candolle's view of a basic plan underlying each natural group - "*suivi avec tenacité mais varié avec richesse*".

These two - in some ways contrasting - modes of evolution are well illustrated in a cross-section through the vertebrates, with cladogenesis involving an enriching diversity at the same level, but anagenesis striking towards higher levels. There is progress, as we may see, from fish to 'four legs', then through reptile and mammal up to primates culminating with humanoids.

Escape from Specialisation
A new morphotype is much less likely to originate from the farthest evolved reaches of any existing one. High specialisation will have gone deep, largely to preclude or cut off alternative options. New progress is kept open by avoiding an overspecialised commitment and holding to something of a generalised plasticity. This is true with the primates among mammals, the mammal precursors in the reptiles, and the first reptiles, with amnion and allantois, arising suddenly from amphibians far more basal than frogs and toads.

One repeated opening to progress has been what de Beer called neoteny or "escape from specialisation". Later appearing specialisations have been lopped off by more basic juvenile forms becoming precociously reproductive, as has been suggested for sea squirts (ascidians). It is a return to a base for a leap forward.

Another happening well explicable from morphic fields could be what Sheldrake has called *evolutionary plagiarism*. One of the most notable examples is the intricate black, white and orange and red mimetic patterns developed in heliconiid butterflies, and imitated with precision, in all its complex detail, in two other families, not by coincidental many-stepped natural selection but far more plausibly, I would even say



EVOLUTION OF THE "WORD" AND THE "PROCESS"
The phylogeny of lobe-finned fishes and Amphibia, showing successive chapters of anagenesis, with each developing the radiate fine branching of cladogenesis

evidently, from the shared use of a morphic field. It could even be that the numerous parallel adaptations in marsupial and placental mammals have been derived by the shared use of morphic fields.

Melinæa imitata (Ithomiinæ) | Heliconius telchinia (Heliconiinæ) | Dismorphia praxinoe (Pieridæ)

Three mimetic butterflies with "heliconiid" black, white and orange pattern. Genetic plagiarism in three separate families is suggested as deriving from the shared use of a morphic field.

A Creative Trinity

Theological models of the Trinity have centred upon its creative work, reaching to humanity and throughout pre-human evolution. John Macquarrie has notably turned from the philosophic revelation of the deity to the existentialism or the notion of Being put forward by Martin Heidegger. In a Christian understanding, we first find God the Father as the original source and potential of a new creative IDEA, not yet particular or incarnate in material substance. His existence (if it can even be called so, being indeed transcendent over all existence) is seen as Primordial Being that we could not know at all were it not pouring itself out in Expressive Being.

Here then appears the second Person, the creative LOGOS, or the WORD. By its productive activity we are brought into a world of finite beings known as particulars, with differentiated properties and structure disposed in space and time. Thus could appear the novel Idea to which we have likened a new morphotype. Both theologian and scientist may approve of the term LOGOS, as the instrument and reason of particular creation, seen as a Person of the transcendent God.
In relation to creation, the Idea could be likened to a new WORD, put into a computer by means of a portable disc. The Word is so introduced with a new particularity that was not there - nor thought of - before.

The SON or LOGOS is then the agent of the Father in new creation. By his eternal action, the Son expresses Being in "the beings" bringing out in us the awareness that we are free and self-determinative, just as the whole creation has been called co-creative - in Bergson's *"évolution creatrice"*.

As we see it, God as Holy Being gives itself and demands our allegiance precisely because it does not gather itself together as pure and immutable. The God-head goes out all the time into the open-ness of a world of beings, a world of change and multiplicity and possibility. So creation happens all the time, at risk with free beings as in mankind choosing for themselves, even if there is in the Process a constant sense in which they are rejecting their being - even becoming alienated from it.

It is in such a world of beings, with societies at present alienated and individuals themselves falling into civil war, that the third person of the Trinity - first with Primordial Being and then with Expressive Being - is now to be recognised as UNITIVE BEING. The creative role of such a Being is to build up separate beings into a higher and wider unity than if Expressive Being had never moved out of the Primordial.

There was first the transcendence of God in the new creation of the WORD. The Word is now - in its very purpose, aim and goal - amenable constantly to PROCESS. This is wide-reaching and packed with unfolding potential. It is a destiny self-elected but always within the nature and ultimate aim of the organism. In human life it is to be realised in service to that aim, processed in accord with the WORD. In humanity - and even for pre-human creation - there is liturgic recognition that such Service can be called perfect Freedom. PROCESS is possible, though never externally enforced, through a God that in the creatures - ourselves and the whole evolving world - can be seen as immanent.

Aristotle's Biology

Confronted with evolution by the PROCESS, co-creative and free, all the while within the organism's own resources and initiative, it is perhaps time to look back to Aristotle. This is far from a retreat to antiquity, but offers a withdrawal from the long shadow still cast by Descartes from the dawning age of science.
No-one has seen this better than Rupert Sheldrake:

> By the scientific revolution of the 17th century nature was denied the traditional attributes of life, the capacity for spontaneous movement and self-organisation. She lost her autonomy. The souls that animated physical bodies in accordance with their own internal ends were exorcised from the mechanistic world of physics. Matter was inanimate and passive, acted upon by eternal forces in accordance with the mathematical laws of motion.

Aristotle was not only the first but probably the most meritorious of biologists in history. In sheer personal range, with no access to books, museums or classification, and with only his young disciples for colleagues, his comprehensiveness was unmatched until the 19th c. Darwin freely yielded to Aristotle the laurel that might have been his own; and his contemporary heroes Linnaeus and Cuvier he held to be mere schoolboys alongside "old Aristotle".

In a way hardly admissible in today's scientific ascendency, Aristotle was a vitalist. He was looking to the intrinsic capacities of whole organisms. He saw the organism "ensouled" with its own psyche, which is the principle of its being. The translation of psyche as "soul" need itself carry no spiritual over-tone of the human rational soul - *nous*. It is the subject material of today's psychology. It is also - with a ring of modern information theory - Dante's *virtu informante*.

Entelechy

It must be psyche that imparts information to unorganised "brute" matter. Without it Matter can have only potential - scarcely as yet real existence. It is then with Soul's instruction that Matter is constituted as a Body; and it is in just such a sense that Soul is the essence of the organism's being. This is what Aristotle called the *entelechy*, as the internal design or purpose. It is to be seen as a principle not just of being but of becoming. Since it is still in the process of becoming, Entelechy could not be said yet to have full realisation. Here it was that Aristotle saw the activity or ongoing movement that characterises all life.

Such movement in life carries a clear - if not explicit - connotation of evolution. Aristotle was probably the first to recognise those graded morphological series that are the ground-stuff of natural classification. It is still a big question whether he saw these natural series genealogically - as we'd say - in time, or as a merely logical *scala* or staircase of self-realisation.

As to the idea of original creation, it is not clear that Aristotle ever speculated. The notion of creation *ex nihilo* - within time or along with time - would have been wholly strange to Greek science, in a world supposedly eternal and perhaps cyclic. Aristotle seems to have been economic too in his thinking about God. He was prepared to see a supreme being as lure and attractant, drawing all life towards him in emulation - almost we could say un-reflective love - of his perfect goodness and beauty. Yet it was hardly credible that the same God should in turn love his creatures (if creatures they were). It was far more likely he wasn't even conscious of them.

Plato and Aristotle walk together - from Raphael

Raphael's portrait of Aristotle and Plato together finely captures their difference of temperament. Plato with gaze aloft is pointing upwards to the transcendant Forms and to the One. Aristotle's contemplation is on the earth, with right hand outstretched and the fingers spread - in that tribute to diversity that is then and always the naturalist's true credential.

Some have found it ironic that a re-discovered Aristotle was to be adopted into Christian theology in the intellectually fertile 13th century. But it has been suggested that while Plato had quite a complete religion

most of it was (by a Christian evaluation) wrong; whereas Aristotle had no religion to speak of, and could therefore more easily be baptised into one. So it was through Aristotle's renovation by St. Thomas Aquinas, in an age when Christianity was after all looking to be rational, that Greek science & philosophy were to find their historic culmination. Aristotle's First Mover by which things have been primordially set in motion ("which men call God") could stand as the foundation of Cosmological Proof in St Thomas' "five ways".

"The Mind of The Maker"

The integration of evolutionary science with natural philosophy could thus bring more intimate understanding from both the theologian's and the naturalist's side. We have looked at John Macquarrie's treatment of a trinitarian deity through something akin to Heidegger's existentialism. But perhaps the first or simplest analogy of the creative work of the Trinity could be from 'The Mind of the Maker' by Dorothy L. Sayers (expositor of catholic theology as well as forensic mysteries). Her picture of God's creative activity is that of a Book being conceived, written and read.

First, the creative IDEA is seen as the image of the FATHER, passionless and timeless, with the book already beholden, needing only to be written. The image of the book becoming actualised is that of the WORD. Here the creative energy is begotten of the IDEA working in time and itself becoming particular, incarnate - that is to say, within the bonds of Matter. The energy in the Word or LOGOS can alone make the IDEA known to itself or others. Yet the creative act is essentially identical with the IDEA.

Finally comes the image of the HOLY SPIRIT. Here is the descriptive POWER of the Book, conceived and then written. It is the way what is written flows back to the writer from his own activity. It is also the way the activity is communicated to the book's readers and produces from them its response. It embodies the biology of co-creation, and the theology of unitive being. It brings together in what Hooker long ago called a "harmonious dissimilitude" a world in which the organism reacts with its own being and upon other beings, and shows itself as co-creative.

This puts together for us in the language of theology what natural science has pointed at without itself explaining. It is looking at the organism co-creating and driven through change by its ENTELECHY that Sheldrake

and his school have once more brought us to recognise. Here is moreover the same evolutionary drive with cladogenesis that follows upon anagenesis, so the whole can be expressed in the thrusting metaphor of PROCESS operating on WORD.

The early belief of the Jewish people, with its picture of a creation out of nothing, stood clearly apart from the other great religions. It moreover still had little of the interest in science that marked the Greeks, in the philosophy of Plato or Aristotle. Yet it has been from Hebraism that Christianity received its unique understanding of a creation not cyclic, but historically progressing and advancing. Here then was a God-head not held remote or automatic, but personal and rational, conferring from the beginning a freedom upon its creation. To explain a creation by laws inflexible and permanent such as the ideal forms of Plato or the changeless laws of nature could amount to something like a science. It could be questioned whether the Platonist philosophic world needed a science at all. But in the degree to which biological science emerged from Aristotle, it was ultimately to be baptised into Christianity. The need for a science moreover was true of Christianity - in a way that could not be ultimately said of the Greeks. To a Platonist, the living world might be explained by laws strictly laid down, with no progressive morphogenic changes. All explanations would thus be theological, with a science strictly un-necessary.

It is in the Jewish and Christian belief that we find an explanation of creation that reflects and indeed calls for science. It is the observation made by science that reveals how creation has in fact used the freedom it was endowed with when the Word came to be realised and set down in time. The original creation at the beginning, out of nothing, is from a transcendant creator in the Logos. Yet it is the same creation that falls thereafter to be pursued by science, as a creation under an immanent God, pursuing the process of evolution in a way perceived as co-creative.

This is far from a closed system to be explained from an original deterministic pattern. Its Godhead now is immanent. In the creature's freedom we can properly see the Word followed in turn and in due course by continuing and variable Process. Freedom and open-ness appear in evolution as the ongoing operation of the created world: they are maximised indeed in human purposive and creative activity. It was the botanist de Candolle - at the very opening of the 19th c. - who saw in each morphotype a living plan *suivi avec tenacité* - but *varié avec*

richesse. In creativity we could so discern a primordial God, transcendent as in the provision of the Idea as the Word, and an immanent God, concerned with the Dance, the Process that is Unitive and yet within its proper bounds co-creative and free.

Science and metaphysics should never confuse their working methods. But if Biology and Christianity are ever in our own day to recognise their need of each other and travel forward together in a natural philosophy of the Word and the Process, their first appointment could be once more a discovery of the Entelechy, true though it be that it can never be finally understood, presenting a state of Becoming rather than Being.

Recasting Establishment History
"The Roots of Science"

Harold Turner

Presented abbreviated as a lecture to the symposium 'Science and Christianity', Auckland 01-4-21.

The 20th century saw the previous century's fascination with the idea of progress replaced by a focus on the term 'culture' as a basic reference point. All human beings and all societies live within one or more cultures; nothing human escapes the cultural. One way of exploring the concept further is to see a culture as made up of the ways in which we habitually relate to the whole human context – the physical context of the natural world, the social context of our fellow humans, and the transcendent context of the spiritual realm[1].

It is the internal relations of two of these, the first and the last, that I deal with in this paper. We relate to the natural world through technology and our knowledge of science, and to the transcendent realm through our religions. On this occasion our theme is "Science and (one particular religion) Christianity". We are therefore dealing with two of the basic features of the Western culture to which we primarily belong: with the central place it gives to science, and with its major religious inheritance from Western European Christendom. These features cannot be examined only in their contemporary forms but first of all historically, for "a culture without a history is like someone without a memory". The history of science, although less than a century old as a discipline, has become essential to our self-understanding; it can help us to see why and how science became such a dominant feature of our culture. The history of Christianity is vastly older but can still produce new dimensions, as we shall see when we come to the long-lost John Philoponus below.

What am I doing here?

In my "Investigative Journey Through the World's Religions" I found the "Roots of Science"[2] in the same historical milieu as the roots of Christendom, within the emerging culture of the Hebrew people over the two millennia BCE. Science and Christianity, as two of the basic cultural

dimensions of Western culture, had their roots historically intertwined. This was in stark contradiction of the received version of the history of science taught in our educational systems. Science, we are told, came from the Greeks, with small inputs from the Arabs and the Indians, and perhaps the Chinese. While still recognizing the specific contributions of each of these peoples[3] I have ventured to say that science developed *in spite of* their cultures, and *only because of* the peculiar features of the culture of a small and insignificant people, the Hebrews.

I am by no means the first to make this radical recasting of the history of science, and I am dependent on substantial historical scholars largely bypassed by the establishment – people such as M. B. Foster in the 1930s when the subject was taking shape as a discipline, C. N. Cochrane in 1940 on the basic intellectual bankruptcy of Graeco-Roman culture, and since then Sam Sambursky, Stanley Jaki, C. B. Kaiser, H. P. Nebelsick, Richard Sorabji and T. F. Torrance among others. Most of these scholars are grouped together by the history of science establishment and dismissed as "revisionists". You will seldom find their names in the indexes or bibliographies of the histories of science, and that in itself starts to tell the story I am exploring.

Now these are all professionals in science, history or philosophy, so how is it that I, neither scientist nor historian, come to be writing about the "historical roots" of science, and making the claim that one of the figures I identify in the Judaeo-Christian tradition, John Philoponus of the 6th century, should be seen as the greatest theoretical natural philosopher before Isaac Newton? How brash can these New Zealanders be?

Laying foundations in Hebrew culture

So I ask myself, how have I come so late in life to be so emphatic on such an unexpected subject for which I had no obvious preparation? The question then becomes autobiographical, and I do not find the answer in my first year of basic sciences as an engineering student, nor in the two years as a demonstrator in the first experimental psychology laboratory in New Zealand, at the university in Christchurch. I now see that the answer to my question lies in another area altogether. The answer begins later, in 1936; there was an entrance scholarship to the theological college of the Presbyterian Church in Dunedin based on an examination in elementary Hebrew to be acquired *before* theological training – a rather unexpected idea for New Zealand. I needed the money and I mugged up enough Hebrew to win it; I don't know if there were any other candidates. Then

for three years Hebrew was a normal requirement, and later I acquired a B.D. degree where it was also essential.

None of this comes anywhere near making me a Hebrew scholar, but it came in handy when in 1955 I had gone to Britain and was applying for any teaching work that came up. I even had enough nerve, or desperation, to apply for a lectureship in Old Testament in something called the University College of Sierra Leone, wherever that was. The position was offered to a real Old Testament scholar, but he withdrew. It seems I was the only other person with "Hebrew" in his c.v. and who was prepared to go to a country in West Africa formerly known as "the white man's grave".

By this queer route I found myself teaching Old Testament in what was recognized as an overseas college of the University of Durham – teaching for the Durham B.A.(Theology) for the laity, where Hebrew was not required, although of course it remained important for the teacher. So for the next seven years I was immersed in the Old Testament. This was an enjoyable and stimulating experience, especially in the multi-cultural situation of the tribal religions and cultures of West Africa. Of course I had no idea that I was getting the feel of that Hebrew culture where I was over 30 years later to find the roots of science.

Religious studies and discovery of the synagogue

During these years I stumbled across the works of the then doyen of religious studies, Mircea Eliade of Chicago, and I discovered this new tool for the study of religions and the world-views at the base of all cultures. Then in 1963 I went to teach religious studies in the new University of Nigeria amid yet another set of cultures. All around was virgin territory for religious research. Besides the tribal shrines and Muslim mosques of Nigeria there were hosts of churches derived from Christian missions and the many varieties of independent African-founded denominations that had in Sierra Leone become a major research subject for me. So one of my projects concerned places of worship, in Nigeria and across all religions.

Fifteen years later this work led to my *From Temple to Meeting House* [4]. Historical and comparative study revealed that the Hebrew synagogue represented a radical revolution in places of worship, over against the classic sacred places of shrine and temple. The following table sets forth the many layers of contrasts I had found between the temple form of worship and the new form constituted by the synagogue[5].

TEMPLE FEATURES	**SYNAGOGUE** FEATURES
Special consecrated place or building	Any secular and non-consecrated building
Gradation of sanctity towards a sanctuary	No gradation of sanctity within building
Sanctuaries as special holy places with altars	No sanctuaries or altars
Priestly control, conduct and leadership	Lay (rabbis) control, conduct and leadership
Worship occasional, for personal needs, and on major communal occasions	Worship regular for all, on daily, weekly, etc. basis, plus special communal occasions
Celebrate mythological and natural events	Celebrate formative historical events
Observational worship: main ritual acts delegated to specialists – priests	Participatory, corporate worship by the whole congregation
Sacrificial offerings and complex rituals	Non-sacrificial, with simple rituals
Special education confined to priests	Education and edification for all.
Community centres for ritual purposes only	Centres for multiple and secular purposes

This led to a two-part typology of worship places for religious studies, the temple type on the one hand, and the meeting house type on the other – hence the title of the book. The latter form first appeared in history in the Jewish synagogue, and then became the ancestor and norm of the churches and mosques in the related Semitic religions, Christianity and Islam. In comparison with the quite different temples of antiquity the synagogue had nothing going for it, either architecturally or aesthetically, and all it needed was ten men in a room in a private house. It was not a sacred place, not consecrated, had no sacrifices or rituals; it had teaching rabbis instead of ordained priests, and in principle it was no different from a Quaker meeting house. When the synagogue was developing, the Jews had no inkling of what they were initiating, but in terms of the history and phenomenology of religions this was a revolution transcending all others in religious history.

I was then entirely innocent of seeing any significance in this for the history of science, just as the reader will be wondering where all this is getting us on the same subject. But it was apparent that the synagogue was the most explicit and visible expression of this so distinctive Hebrew culture with its radically de-sacralized view of nature – a totally new

worldview in human history. That is why in this discussion it occupies the central place as representative of the first formulations of the view of the created world in the Judaeo-Christian tradition. In the synagogue, matter, space, time and human beings had all been de-sacralized.

Encountering Philoponus

These are some of the main features of my intellectual autobiography up to 1979, but there was still no sign of insights into "the roots of science". Then in the *Scottish Journal of Theology* Professor T. F. Torrance of Edinburgh reported a conference in London in 1983 of 75 scholars devoted to the study of a 6th-c. Christian layman of whom I had never heard. This was John Philoponus, a philosopher in the great Academy in Alexandria. I already knew Torrance as a leader in the relations between theology and science, in which I was interested in a general sort of way. Now Torrance was presenting Philoponus' natural philosophy as a key development in the history of science. This was worth following up, which I have been doing with growing fascination ever since.

Now how did Philoponus shape my thinking and link up with Hebrew culture and its synagogue on the one hand, and with the book I have written on the other? We must start from Aristotle of Athens, the most comprehensive and influential thinker in antiquity in almost all realms. He dominated European thought until well into its second millennium and continues to provide courses of study in our universities[6]. Likewise he dominates the history of science when its origins are traced to the Greeks. Here we are concerned only with Aristotle's natural philosophy, especially with his physics, the basic science.

John Philoponus (ca. 490 - ca. 566; the name means workaholic) has been called the most learned man of his time, and the Academy at Alexandria was for long established as the greatest centre of learning in the Graeco-Roman world. He was an expert on Aristotle, for whom he had the greatest respect; he had adopted much of his system and wrote commentaries on nine of his works. In these he was led to make a number of radical rejections of Aristotle's natural philosophy, all of which proved essential for the later development of what we know as science[7].

De-sacralizing the heavens

One of the most radical changes was to reject the distinction between the earth as an imperfect sub-lunary body and all the other

supra-lunary bodies, outside the orbit of the moon; these were perfect, animated and divine beings, a view which is the basis of astrology. For Philoponus all bodies, earthly and heavenly, were made of the same stuff. The light of the stars was the same as the light of a glow-worm – a sheer heresy in the Greek world.

Nor was the universe eternal, or moving in eternal cycles of time; it had a beginning and now had a history, for it was made out of nothing by the Creator God of the Scriptures, not by mere fabrication out of pre-existing material. These radical changes involved a totally new view of the fundamentals of the physical universe. Matter, and with it space, had been de-sacralized, as well also as time. Nor did space contain any inherently sacred places beyond human scrutiny and control. The whole universe outside the earth had been de-divinized and brought into the same categories as this imperfect earth. Matter, space and time were all of a piece anywhere in the universe and were open to human investigation.

This was a revolutionary worldview, asserting the unity and uniformity of the whole universe. Philoponus was rejecting what C. N. Cochrane called "the most vicious of heresies, the heresy of two worlds"[8]. The basic distinction now was between the Creator and the creation, between the sacred located in the divine, and the secular universe where human beings were placed and for which they were responsible. With this new natural philosophy the world had been cleared of gods and spirits, declared to be the good creation of the one rational God, and the foundations had been laid ready for the study of the universe that we know as science.

Impetus: a second form of motion

Philoponus' second critique concerned another basic concept in physics, that of the motion of material bodies. For Aristotle this was always due to a mover external to the body moved. The issue was discussed in terms of the motion of a projectile. Aristotle explained this as due to the air displaced from the front end rushing down alongside the projectile and then turning in to prevent a vacuum developing behind it and so impelling the projectile as an external force from the rear; a void was an impossibility for Aristotle.

Philoponus made mock of this as "bordering on the fantastic". He proposed a thought-experiment where 10,000 wind machines blew upon

the rear of a row of military projectiles balanced upon the wall of a fortress. Instead of taking off into flight, he said, they would simply fall to the ground a little away from the wall; which of course was true. Philoponus' caustic comment was matched by my wife, for before I had quite finished explaining Aristotle's view she burst into laughter! I know it is not quite fair to mock a great man, for his theory was all of a piece with the rest of his physics; but this was simply wrong, as Philoponus' simple thought-experiment would have shown him if tested. The experimental method, however, was still some two millennia ahead of Aristotle, and another millennium of Philoponus.

In place of all motion being due to an external cause Philoponus proposed a further kind of motion imparted to the projectile and then retained internally by it when the external force was removed. This transfer from external to internal force opened up the concept of impetus given to a moving body. This was a radical development in physics that was further developed by the time of Newton into the concepts of inertia and the momentum possessed by a moving object. This was Newton's first law of motion – that once launched, a moving body would continue in a straight line indefinitely, unless something interfered. Although Philoponus regarded the internal force not as permanent but as fading out[9], he had made the radical break from the system of Aristotle into kinetic theory.

A natural philosophy replacing Aristotle's

In other breaks from Aristotelian orthodoxy Philoponus affirmed the reality of a vacuum or void, and anticipated Galileo on the equal acceleration of bodies of different weights when dropped together from a height. Aristotle had taught that their speeds would be proportional to their weights. Philoponus also replaced Aristotle's static theory of light by a dynamic theory of particles moving from the external seen object to the eye at almost infinite velocity; this is congruent with James Clerk Maxwell's discovery that both light and electro-magnetic radiations travelled at the same very high speeds.

It would be pretentious to downgrade Aristotle, perhaps the greatest and most influential mind of antiquity; despite his errors in these areas he offered the greatest overall stimulus by any one person towards what has emerged as science. But Aristotle's physics was simply wrong on the eternity of the universe, on the dualism of its two divisions perfect and imperfect, and therefore on the different composition of the heavens as

against the earth, wrong again on the impossibility of a void, on the cause of the motion of a projectile, and on the rate of acceleration of dropped objects.

It is these remarkable corrections by Philoponus, seen as 6th-c. anticipations of Galileo, Newton and Maxwell, that support my description of Philoponus as the greatest natural philosopher before Newton. When we consider also that all this was without benefit of the experimental method and mathematical proofs that mark modern science we are compelled to ask where Philoponus got it all from. The answer to this question will bring us back to where we left off with Hebrew culture and the synagogue.

Were there earlier thinkers among the Greeks who anticipated Philoponus in his new ideas? The chief candidate for this role has been the learned astronomical observer Hipparchus of Nicaea (ca.190 - ca.125 BCE) in whom Galileo and many modern scholars have found the precursor of the impetus theory. In the 1993 London conference on Philoponus, Michael Wolff effectively disposed of an Hipparchian origin, placed Hipparchus firmly back within Aristotelianism, and concluded that apart from Philoponus there was no ancient author who argues for impetus in any sense[10].

Scientific stirrings among the Ionians

In the 6th c, a de-sacralized universe had appeared among the very first Greek philosophers, in the colonists in the cities of Miletus and Ephesus in the Ionian area of Asia Minor. Here Thales and others took the first critical steps towards science, towards a rational and unified view of the universe. They asked new questions that sought causes within nature itself, and so left the capricious Olympian gods out. They were materialists and monists with no personification or deification of nature; they totally de-sacralized it. Likewise, another Ionian, Democritus in the 5th c, saw the world as the random movement of tiny atoms – a mechanistic view that returned in the 17th century of our era and is still influential in science and the popular mind today.

In the same 6th c. other new scientific ideas emerged among Greek colonists to the west, in southern Italy, where Pythagoras (originally an Ionian) developed a unified view of the world as either actually consisting of numbers or at least ordered mathematically. For this and his work in arithmetic and geometry that anticipated Euclid he has been called “the father of science”. There was a potentiality here to de-

sacralize the world, like the other Ionians; on the contrary there was a religious side to the Pythagorean movement with features that were no advance on those found in various tribal faiths and their religious cultures.

Then in the 5th c. another of the pre-Socratic philosophers and again an Ionian, Anaxagoras, had brought new ideas of the universe to Athens itself. Based on the evidence of a meteorite he suggested that the heavenly bodies might be composed of stone-like materials as found on earth, and that the sun was a large incandescent stone. This de-sacralization anticipated Philoponus' views a millennium later, and also what Galileo saw through his telescope after a further millennium. For such heresy Anaxagoras was prosecuted and had to return to Ionia.

Philosophers' revival of the sacred

In the great 4th c. BCE Plato and Aristotle would have none of these first sights of science, for in removing divinity from the world the Ionians had also deprived it of plan and purpose. So the Athenian philosophers restored these features to the world of nature in the form of Plato's Demiurge, a rational divine craftsman, or of Aristotle's Prime Unmoved Mover. These were living deities, far removed from the anthropomorphic Greek gods. Ultimately, however, they were no more than philosophers' creations which were never able to become the objects of worship in the cult of any actual religion.

Despite its magnificent deposits in literature, art and architecture, its philosophic wrestlings and scientific searchings, its Euclid and Archimedes, its late flowering in Ptolemy and Galen, despite "the glory that was Greece", its gods were either too close and too human, or too remote and impersonal. Greece went into decline and its great Athenian schools were closed by the 2nd c. CE. A wholly new theology was needed, a re-thinking of what was meant by "divinity". Amid the decline of the Graeco-Roman world, this was supplied by the theology developing among the unimportant Hebrew people and in the ensuing Christian tradition. As C. N. Cochrane put it in philosophic terms[11], the new doctrine of the trinitarian God answered the unsolved Greek problem of the relation of the one to the many, the relation of the ultimate unities of the philosophers to the rampant pluralism of the Olympic divinities.

And so to return empty-handed after our search among the Greeks for the origins of Philoponus' radical departure from Aristotelian natural

philosophy. In fairness to Aristotle we must remember that both he and Philoponus were working deductively from their respective worldviews. They got no closer to the later experimental inductive methods than Aristotle with his remarkable biological researches, and Philoponus with his imaginative thought-experiments and some common-sense observations. They were both dependent on the assumptions and concepts of the worldviews available to them, the one in Athens in the 4th c. BCE, the other in Alexandria nearly nine centuries later. In what had happened during those centuries in the world of Philoponus we shall find the clues to his remarkable critiques of Aristotle.

The Alexandrian heritage

Philoponus was working over Aristotle's questions and answers, but from a quite different "fiduciary stance". The Academy at Alexandria possessed a long tradition from pre-Christian times. By the second century BCE, here at this same Alexandria the first translation of the Hebrew scriptures had been completed, into Greek as the Septuagint, which later gave Christian scholars ready access to the book of *Genesis* with its creation stories. Around the turn of the millennium Alexandria had been the largest Jewish city in the world with Philo, a contemporary of Jesus, as its greatest Jewish scholar. From the 2nd c. CE Alexandria had been a major centre of church organization and Christian theology and remained so during the five centuries of Christian thinkers, the patristic period, the age of the Fathers of the Church that produced the classic or ecumenical creeds.

There was also the new doctrine of the created universe, although less prominent in the creeds. By the end of the 1st c. CE Clement of Rome was rejecting Greek dualism, insisting that there was only one universe, all of a piece, created good and orderly by God. In *The Roots of Science* I have summarized the similar contributions of Clement's successors: Athenagoras in Alexandria itself, Tertullian, the other Clement (of Alexandria), Origen, Athanasius, Augustine, and Boethius with his great "Hymn to the Creator" and only a decade younger than Philoponus. Further afield Basil in Cappadocia affirmed the same single created universe, and used everyday observations in support – the eternity of the universe was not represented by the circle, because to draw it one had to start and stop somewhere. Likewise he was on the verge of impetus theory in its alternative circular form when he likened the Creator setting the universe in motion to a child setting a top spinning – continuing indefinitely if there was no resistance.

Amid much debate a new doctrine of the universe was being defined. As the patristic period was ending it provided a new cultural atmosphere in natural philosophy, and it was Philoponus who articulated this in a way that has remained substantially intact ever since.

We should also observe that the only place of Jewish worship that the Christian scholars ever saw was the synagogue which implicitly and publicly summed up the central feature of the new worldview, a de-sacralized universe. There is no suggestion that Philoponus ever thought in these particular terms about places of worship; but for me I had already taken the synagogue as an authentic expression of the biblical worldview where the roots of his natural philosophy also lay. This is how the unexpected intrusion of this new figure into my thinking made sense, as I explored Philoponus working out the physical behaviour of a de-divinized Judaeo-Christian creation in ways that supported my synagogue thesis.

Why then do we hear no more of him?

The immediate question arises: if Philoponus is of this stature why does he not replace the Greeks, and especially Aristotle the most influential of them all, in the succeeding history of science? There are many factors of various import in the answer. The Roman empire was collapsing, and Philoponus stood at the apparent end of Graeco-Roman culture, with the invasions of tribal barbarians from the north and of Islamic armies from east and south. The Greek-speaking Academy at Alexandria came to an end when the city was captured in 646 by the Muslims and much of its library of Greek manuscripts was carried off to their centre of learning in Damascus. Here, and later in their new city of Baghdad and at the Nestorian Christian centre at Nisibis which Islam controlled, these manuscripts were translated into Syriac and Arabic, but not into Latin. Thus it was that the cultural deposits of classical antiquity, including Aristotle and his later commentators and critics such as Philoponus, lay in the east, out of reach of the Latin-speaking Western scholarship during its so-called “dark ages”.

This loose term covers some six succeeding centuries when there were cathedral and monastic schools with their more modest libraries, developed for the education of the clergy. The fate of Philoponus’ scientific achievements was tied to the sad fate of great centres of learning such as the academies at Alexandria, Athens and elsewhere. These were not replaced until the mediaeval European universities

developed in the west, in the 12th to the 14th centuries, more independently of the church schools and with wider agenda. These gave science its necessary institutional base, but they were still largely tied to their limited Latin resources, and knew little directly of Plato or Aristotle and almost nothing of Philoponus.

Then classical learning began to filter through to the west by renewed contact through merchants and Crusaders, especially the Fourth Crusade which looted Constantinople in 1204, and above all through the Muslim invasions and the Islamic scholars and resources they brought with them. Thus began the European recovery of the impressive resources of classical Greece that had been preserved and translated in Islam's eastern centres of learning. Aristotle was rediscovered, along with his commentators and Philoponus among them. Widely distributed Arabic scholars such as the Persian Avicenna (980-1037), and the Spaniards Avempace (d. 1138) and Averroes (1126-1198), were well aware of the dispute between Aristotelianism and Philoponus over impetus and the eternity of the universe and other matters, but came to no agreed conclusions, and in effect favoured Aristotle. Zimmerman points out why the Christians who should have been promoting Philoponus and so hastening the development of science were in fact doing the opposite – since he was an embarrassment to them. As Zimmerman puts it: "… the name of Philoponus did not … inspire trust and admiration … his reputation was flawed. For in the eyes of posterity he had doubly disgraced himself by embracing the short-lived Tritheist faction within the Monophysite party and by attacking … his own school (the philosophical tradition from Aristotle to Proclus) from behind ... His writings, then and later, enjoyed notoriety rather than authority … His impetus theory seems to be a case in point: it was adopted without due credit given to its author."[12]

A heretical "monophysite"?

With these theological charges of heresy we come to the heart of the tragic history and subsequent obscurity of Philoponus. Not long before his time, in 451, the Council of Chalcedon had debated the relation between the two "natures" of Jesus Christ, the divine and the human. It had apparently reconciled the different formulas presented, and issued the famous four-point epistemological guidelines that I suggest are still basic to all thinking today[13]. Different parties, however, were using key words in different senses; the Constantinople (Byzantium) theologians were still under the influence of Greek dualism, whereas the Alexandrians were

suspected of a monist emphasis upon the one "nature", the divine, and so were branded as heretical Monophysites (one "phusis" or "nature"). The issue was vital, and had really been neither solved nor settled at Chalcedon.

Ultimately it arose from the fact that the new Judaeo-Christian worldview was being hammered out by the early Christian Fathers in Alexandria with greater freedom there from Aristotelianism than in the heart of the Byzantine empire. This new worldview, like any such major change, required changed meanings in old terms and some new terms altogether. The New Testament had already done this within the common Greek language of its day; Faraday, Maxwell, and Einstein did it again in physics, and we have all had to repeat the process in the new computer world.

This process had begun among predecessors of Philoponus at Alexandria such as Athanasius (d. 373) and Cyril (375-444), as well as Severus (465-535) at Antioch. It is impossible here to follow the various political, ecclesiastical and theological factors at work in several centuries of turgid history, nor the various degrees, as it were, of monophysitism, and the arguments about the use of key words and the effects of different contexts upon their meanings. The overall result was that the Byzantines won and Philoponus was posthumously placed under an anathema as a heretical monophysite and tritheist by the third Council of Constantinople (680-81). This was confirmed by Photius, the powerful Patriarch of Constantinople in the 9th c. "Aristotle became the one officially licensed philosopher of the Byzantine world."[14] This "retarded scientific development for a thousand years and contributed to the domination of Aristotelianism in the West. That was one of the greatest tragedies in the history of thought."[14]

Henceforth, and most importantly when the universities and the sciences were developing in Europe, Christian scholars eschewed him. Aquinas, for example, being no scientist, firmly rejected the impetus theory of projectile motion in favour of Aristotle's view[15]. Philoponus the heretic was left to the Muslims. Although their theology could not accommodate to him, it was through them that his ideas about the universe and impetus, etc., percolated through without acknowledgement and surfaced as new discoveries for use in the controversies with the Aristotelians. It is true that Christian critique of Aristotelian science took specific shape in the 219 propositions issued in 1277 by the Bishop of Paris that included most

of Philoponus' positions, and later scholars like Buridan and Oresme made advances in impetus and other scientific theory, using the resources of the same Judaeo-Christian tradition upon which Philoponus drew. But he himself had almost vanished from the scene.

The long wait for recognition

The anathema of 681 remained in place for over 13 centuries until through the initiative of Professor T. F. Torrance the Greek Orthodox Church formally lifted it in the 1990s. In a series of studies, some unpublished, Professor Torrance has detailed the language issues, especially as between the terms for "nature" and for "reality" or "truth"[16]. He has shown that Philoponus was no monophysite or tritheist, and also why he was misunderstood in these ways, as he sought to go beyond the static thought-world and logic of the Greeks into the more dynamic way of thinking opened up by his ideas about impetus and about light. This judgement is confirmed by the way the eastern churches, Coptic, Syrian and Armenian, rejected as "monophysite" by Western churches for well over a millennium, have in more recent times been informally recognized as orthodox.

A setback of "a thousand years" – a vast exaggeration, surely? Not if one realizes that when the great scientific development came in the 17th century it was still distorted by the continuing Greek dualism of Descartes and later of Kant. It was something like a millennium after Photius that Faraday and Maxwell broke through to a new dynamic and relational way of thinking, with fields of force that had their first anticipations in the writings of Philoponus. As Christians, all working from their fiduciary stance in trinitarian relational theology, they might well have understood one another.

Here we may speculate upon one of the great might-have-beens of history, greater even than the 17th-c. prospect of a French-speaking North America, or the mid-19th-c. possibility of a nominally Christian China under the Taiping revolution. If Christians had used Philoponus instead of suppressing him, the mediaeval dominance of Aristotle might have ended sooner, and the experimental method and other prerequisites might have developed faster. The historians have missed this might-have-been, but history is full of examples and only some of the more obvious ever receive attention.

The rediscovery of Philoponus after a millennium began in the Renaissance period, when the newly accumulated resources of classical culture through Arabic channels made their public impact on Europe, and the effect of church anathemas on any of their authors might well have been counter-productive among the Renaissance humanists. In the 16th c. the recent advent of printing made the works of Aristotle and all his commentators readily available in Greek, and these were usually shortly followed by Latin translations. Thus it was that Philoponus at last became freely available, as evidenced by his *Physics* appearing in Latin versions nine times between 1546 and 1581[17].

The major figures in the 17th-c. scientific revolution therefore had access to Philoponus, and Galileo thought highly of him. The question then arises: why does he seem to have fallen out of sight for the second time, and again for centuries? In the founding period of modern science most of the leading figures were Christians of one kind or another, so that as a major and early Christian critic of Aristotle he might even have received a certain respect. I have asked around on this question and no-one seems to have an answer. It seems inadequate to suggest that his basic ideas had already been developed beyond his formulations, and that experimental and mathematical methods had replaced his deductive procedures, so that he would not be attuned to the modern scientific atmosphere. The 17th-c. scholars must be excused as not being historians of science in the new 20th-c. manner.

The re-rediscovery of Philoponus

The modern re-rediscovery might be said to have begun in 1847 when the early contribution of Philoponus to the development of impetus theory was warmly recognized by the German naturalist Alexander von Humbolt[18]. There was a flurry of interest in the decade around the year 1900, when the Berlin Academy of Sciences published German translations of some of Philoponus' works. Von Humboldt was picked up and developed rather uncertainly by Emil Wohlwill in an essay in 1906[19]. But the first to take Philoponus seriously in the history of impetus theory was one of the founders of the modern history of science, Pierre Duhem, as in a 1913 essay[20]. Only eight years later, the *only* reference to Philoponus in the great 12-volume Hastings *Encyclopaedia of Religion and Ethics* was in an article on "Tritheism" (of all places) where he was described as a "distinguished Aristotelian", a monophysite and virtually a tritheist – wrong at every point. This is doubly offensive when I find it was written by the professor of systematic theology in the university

where I had my longest and happiest stay, Aberdeen. Unhappily, and surprisingly, this great encyclopaedia, finished in 1921, is still in print in 2001 and so continues to propagate this major error.

The availability of Philoponus in English for serious study commences in 1948 with seven pages of text from his commentary on Aristotle's *Physics* [21]. A similar source followed in 1955[22], and by 1962 Philoponus rated discussion in a whole final chapter[23]. One might have expected more than one passing reference in Stanley Jaki's Gifford Lectures in 1974-75, but he devotes three pages to Philoponus in his 1986 *Science and Creation*[24]. The main work now is the collection of scholarly essays on Philoponus, some of which have been quoted above, edited by Richard Sorabji in 1987[25]. That the publishing programme of reliable texts initiated at the 1983 London conference is well under way is indicated by the items by or associated with Philoponus now in the library of the University of Auckland. Apart from two translations in French and German, and the early works mentioned above and Sorabji, there are at last checking twelve works of Philoponus himself in English; all of these have been added since 1983, and most in the last few years.

Clearly he is coming into his own in the history of science. But much has yet to be done for he does not rate a personal entry in the recent 900-page *Reader's Guide to the History of Science* [26]. It is an illuminating exercise to look for the name of Philoponus in the indexes of works by historians of both science and of Christianity. The content of history of science and Church history courses would be equally revealing. Be prepared for disappointment, for total absence or a mere passing mention or even for gross error. *The Oxford Dictionary of the Christian Church* has an entry for Philoponus, but still in 1997 leaves him as a condemned monophysite[27].

Philoponus and the synagogue

It might appear that in this extensive treatment of the neglected Philoponus we are a long way from the synagogue, which I used as a sign of the Judaeo-Christian de-sacralization of the world. Yet behind our account there has been the ongoing articulation of the Christian doctrine of the created world, whether recognized or not as providing the basic worldview and metaphysics necessary for the work of science – a basis I have summed up in the uniqueness of the synagogue among the world's places of worship. Since my study in this area was published in 1979 there have been two crowded decades of discovery of Philoponus and the

Christian Fathers in support of my de-sacralization thesis and its meaning for science.

That is my story. First the apprenticeship in studies of the Hebrew Scriptures, then the application of religious studies to places of worship and discovery of the revolutionary significance of the synagogue, followed by realizing that the de-sacralization of the world represented so vividly in the synagogue was the same as the de-sacralized worldview of this new figure John Philoponus. And so it was that I ventured to write *The Roots of Science,* showing that the abandonment of the world of temples and the collapse of the Aristotelian world were different expressions of the Judaeo-Christian view of the universe. Since this book was confined to the historical *roots* of science up to the 17th-c. developments, I found I had to extend this history into our own era in the subsequent *Frames of Mind*, and as a further testing of the thesis as to the necessary relation between science and the Christian religion.

From dualistic Cartesianism to relational field theory

This I did with critiques of the dualism of two key figures, Descartes and Kant, and with inquiry into the inter-relation of faith and science in Michael Faraday and James Clerk Maxwell – the key figures in the transposition from Cartesianism into the scientific world of Einstein, Rutherford, Bohr and so many others of distinction. The biographies of Faraday and Maxwell show how their scientific work and their religious faith were distinguished but never separated. We can see that they came to their scientific inquiries with minds already and continually shaped by the unique trinitarian relational view of God, and found that this was reflected in the relational structures of nature, with their interacting fields of force. They were not producing an argument from nature's evident design to the existence of nature's unseen Designer; their independent convictions about the Designer made them receptive to this kind of Designer's handiwork all around them in nature.

The roots of science and its ongoing development up till our own era therefore depend on theologies – on emancipation from the theology and accompanying worldview of the Greeks and on the adoption of the Judaeo-Christian theology and worldview first developed among the Hebrews. These are sharp alternatives, not matters of degree.

I am now placing Philoponus and the Faraday-Maxwell combination at two of the key points in the history of science, where they broke from the

ontology, epistemology and cosmology[28] of the Greek dualist worldview, and replaced it with a more unified, relational and dynamic understanding that corresponds more closely to the way things actually are in the universe. The breakthrough occurred in principle in the 6th c. and might have moved into practice much earlier but for the tragic fate of Philoponus, for which Christians were mainly to blame. The dualist position not only of the Greeks but also of the Axial faiths of Asia was long in the dying in the science of the Western world, for its final obsequies only began in the middle of the 19th c.

Christianity in the happenstance theory

Modern historians of science are mostly prepared to accept a modicum of Judaeo-Christian influence as a contributory factor among the complex of factors evident in that history, but not as the essential basis. I fully recognize that this worldview although absolutely necessary is not in itself sufficient for the rise of science which had to await the historical appearance of alphabetic languages, decimals, the re-discovery of the Greek natural philosophers, Arabic enumeration, universities, technologies such as accurate time measurement and the telescope and microscope, and socio-economic and political changes that provided wealth, leisure and freedom of inquiry and debate, not forgetting the unpredictable individuals of genius like Copernicus, Galileo and Newton. Then this multi-factor theory asserts that this fortunate combination of factors, happening in the later centuries of a Europe civilized by Christendom, this unique mix at last had all the ingredients for the birth of science in the 17th c. It is the "happenstance" view of history, asserting that there was no primacy or hierarchy among these factors, and that such a combination might well have occurred in a number of other great cultures – China with its amazing technologies and wealth of resources is often the favoured alternative, although below we see that this was rejected by its chief authority[29].

This so-called happenstance assembly of factors was by no means casual but was interlocked in known and unknown ways, and especially interlocked with some aspect or other of the comprehensive worldview that was ousting that of the Greeks. At this level there are the three sharp cosmological alternatives that I have presented in the opening sections of *The Roots of Science,* and this essay is a fuller account of how I have come to choose the Judaeo-Christian option.

This is the "revisionist" position – properly it should be "radical revisionist" since all history is liable to have a degree of revision, or

simply "recasting" as in my title. It was well summarized over five pages in an essay by Rolf Gruner back in 1975 (but with no mention of Philoponus), and then rejected as a biased apologetic rather than serious history[30].

The rejection of revisionist history

A compact rejection of the "revisionist thesis" occurs in an excellent book to which I am much indebted, Geoffrey Cantor's *Michael Faraday: Sandemanian and Scientist* [31], which studies the relation between Faraday's science and his Christian belief as a devoted member of this small (now extinct) Christian church. Unfortunately there is a gratuitous paragraph in the Epilogue summing up the "extreme version" of the revisionist argument, wherein "its proponents (usually Protestants)[32] argue that Christianity and Christianity alone provided the essential soil from which modern science grew". I am guilty therefore of extremism, which more balanced historians presumably avoid, but I do share this with eminent Catholics, notably Pierre Duhem (Catholic physicist-historian), and especially Stanley Jaki (Benedictine physicist-historian).

"Extremism" is a senseless criterion when thus applied. Must the truth about nature be balanced somewhere between the opposed extremes of Aristotle and Philoponus? One of the Fathers, Origen, tried something like this when he demoted the divine and perfect heavenly bodies to the status of fallen angels, nearer to the class of us human beings, but that didn't improve his astrology. Nor did the truth about the solar system lie in some balance between Ptolemy's geocentrism and the heliocentrism of Copernicus. Ptolemy was simply wrong, and when Kepler came to refine the Copernican system it was not by any movement towards the Ptolemaic. A "balanced view" applies when evaluating a large complex of factors and should mean "giving each factor its due"; when applied *simpliciter* to the many either/or situations in history it quickly becomes ridiculous. Sometimes the truth happens to be at an extreme of some range of possibilities. Shunning of extremes is certainly not a principle of epistemology.

Cantor's paragraph then proceeds: "There are many arguments against this strong version of the revisionist thesis: for example, it depreciates Greek, Islamic and Chinese science." Even in my small *The Roots of Science* I took particular care to avoid this and devoted some five pages to outlining Egyptian, Greek, Indian and Chinese achievements, and later

some seven pages to those of Islam, and the impasse that prevented the further development of Islamic science.

He then adds the question as to why, on the revisionist theory, "modern science had to wait in the wings during some 16 centuries of Christianity". We might ask the parallel question of why the Greek influence had to wait a similar length of time between its classical period in the Athenian academies and its massive impact on mediaeval Western Europe. The collapse of the Hellenic and Roman empires and the rise of the Islamic are well-known factors, and the second factor, the entrance of Islam, is shared by both questions. There is nothing at all unusual in what Cantor turns into a criticism.

In the Christian case I have explained the two main causes of this delay. Firstly, it was internal conflicts and misunderstandings that long prevented the epochal work of Philoponus from bearing fruit. Secondly, the Judaeo-Christian worldview, though essential and basic, was not sufficient in itself to support the emergence of modern science in the 17th c.; the convergence of other contributory factors was also required, and some of these were themselves products of mediaeval Christendom. Even if freed from his anathema Philoponus would probably not have been followed up in the "dark ages"; and then his battles with Aristotelianism would still have had to be fought again by others in the succeeding mediaeval period.

Any historian knows that Christianity was far from "waiting in the wings during some 16 centuries", as it were idling instead of snapping into modern science. It spent some six centuries articulating its new theology and untangling itself from Greek and gnostic influences, some five centuries providing the only framework for administration and scholarship after the collapse of the Roman empire, then four centuries setting up the first great attempt at a synthesis between the Gospel and culture in public life known as Christendom. This included fighting the renewed Aristotelianism, founding universities as an institutional base for science, encouraging scholarship further in mathematics and physics, and finally attempting a radical internal critique of its own history in the Reformation. It had a pretty busy 16 centuries where it was deeply involved in the - to us - slow processes of history; and when the times were ready it was mainly Christians with a biblical view of creation who took the great leap forward and then founded the Royal Society, the first "scientific guild" in England.

Cantor's final criticism is that "revisionists are hard put to find passages in the Bible that are manifestly conducive to modern science". The answer lies not in some verses of literal support, but in the doctrine of creation and its Creator contained in those outstanding first two chapters of *Genesis*, in Psalm 104 and running through the whole Bible. More precisely, this worldview makes science *possible* with its orderly structured universe and with human minds similarly structured to understand this, and makes science *necessary* if humans are to carry out their responsible stewardship within creation and to worship with understanding[33]. It is not revisionism that "turns out to be untenable" but rather each sentence in this unfortunate paragraph.

If not the Greeks, then the Chinese?

The main alternative contender for the origins of science is China, as presented by the greatest Western sinologist of the 20th c., Joseph Needham. His multi-volume and enthusiastic *Science and Civilization in China*[34] is a fascinating account of the manifold and amazing achievements of Chinese technology and scientific interests when Europe consisted mostly of barbarian tribes. I cannot resist one example: in the 2nd c. BCE they had rigs with steel drilling bits on the end of sectioned bamboo pipes, operated like a modern hammer drill with both rotary and vertical motion, penetrating over 600 metres for natural gas and for brine, and then burning the gas to evaporate the brine for production of salt. And along with technology there were more theoretical achievements such as concerning magnetism, and including decimals and place value for numerals – according to Needham, before these were discovered in India.

The question therefore that faced him was why science developed only in the West when China was so far ahead in so many areas both practical and theoretical. In *The Grand Titration: Science and Society in East and West* Needham returns to this question at the end of every essay, and repeatedly admits "the undeniable fact that *modern* science was born in Europe and only in Europe"[35]. In attempted explanation he rules out Caucasian racial superiority, and also the happenstance theory for this "is to declare the bankruptcy of history as a form of enlightenment of the human mind".[36]

His explanations include the defects of Chinese philosophy, especially that "It was not that there was no order in Nature for the Chinese, but rather that it was not an order ordained by a rational personal being, and

hence there was no conviction that rational personal beings would be able to spell out in their lesser earthly languages the divine code of laws which he had decreed beforetime".[37] The "ideas of a Supreme Being … present from the earliest times, became depersonalized so soon and … lacked the idea of creativity, that they prevented the … conception of laws ordained from the beginning by a celestial lawgiver for non-human nature" – *i.e.* laws of nature[38]. The arbitrary dualism of the Yin and Yang structure of the universe, and the polytheism of lesser gods, were no substitute for such a rational, personal ultimate being; the contrast with the Judaeo-Christian worldview is obvious.

Needham (1900-95) was a liturgically-minded Anglo-Catholic with a liberal theology mixed with the Marxism common among Cambridge intellectuals in the 1930s. He had actually tried out a vocation for the priesthood. His Christianity therefore was especially unfitted to recognize the Judaeo-Christian view of the universe and its law-giving Creator as the exact answer to the defect he identified so accurately in Chinese culture. Instead of looking to what he saw as an old-fashioned pre-scientific Christian tradition, he declared over and over again that the explanation of the European birth of science would emerge from fuller analysis not of the theological but of the sociological factors. In this weak answer Needham focussed on the Renaissance which brought the Greek originators of science into play, along with the development of mercantile and industrial capitalism lacking in China but free to support and exploit new developments in Europe. He was therefore not what many would make him, a "revisionist" on behalf of China, and he was a long, long way from the Hebrew worldview I have summarized in the synagogue, which lay behind a Philoponus[39].

Explaining and closing the gap in the history of science

In finding the roots of science in the Judaeo-Christian worldview I do not intend to denigrate the immense amount of scholarly work in the history of science by professional historians and scientists in its short history since the 1930s. They could not possibly have been expected to start by looking to the Hebrews who had neither science nor notable technology and little philosophy, much less by learning Hebrew and studying the Hebrew Scriptures and the history of Israel and of its places of worship. Nor can they be expected to have found any significant cosmology or worldview in such a mundane object as the synagogue. Yet again, they cannot be blamed for not exploring the Christian theologians of the patristic period and its lead up to Philoponus. Indeed many modern patristic scholars themselves show little sense of his significance,

for they are not geared to the history of science, and he is uniformly absent from church histories. From the viewpoint of many in other disciplines in a modern university, and indeed for too many in the churches, the study of Israel is archaic, and the early Christian centuries are seen as full of hair-splitting debates about arcane and useless matters such as an alleged trinitarian God and the incarnate divinity of Jesus.

This atmosphere does not encourage would-be historians of science to look in the Judaeo-Christian direction, so that most have hardly even heard of Philoponus. All this means that the evidence from some two millennia of history that has proved to be of the greatest cultural significance in the making of the modern world has been effectively ignored in the history of science, and certainly in its most popular exponents. This defect is of the utmost seriousness, but the blame can hardly be placed upon these modern scholars; they have been the victims of the resources, the institutions and the culture with which they have been presented. The current emphasis upon the relevance of context within their own discipline applies firstly and clearly to themselves.

My own history and resources have been unexpectedly rich in the very areas where the science historians have been deprived. In no sense is this or my personal discovery of Philoponus to my credit, although I may perhaps take some satisfaction from seeing his significance and relating this to the same significance in the synagogue. In New Testament teaching the Jerusalem temple is not replaced by the synagogue but by the personalized "new temple" as in the *Epistle to the Hebrews.* By the same token there is no physical temple in the vision of the heavenly Jerusalem in *The Revelation of St. John* [40]. The revolutionary import of the synagogue is not explored in the biblical texts. It is taken for granted alongside the temple, and is not reflected upon in comparison with the worship places of other faiths as in the modern discipline of religious studies where it assumes a quite new significance.

Next steps for historians of science

Historians of science are now offered a whole new area of research into what I have called the two millennia of unused data. The relation of their discipline to other disciplines waits to be explored. Some will need to work on biblical studies to uncover and articulate in a more specialized way the Judaeo-Christian view of the physical universe and its relation to the foundations of science. There will be comparative work with religious studies on the synagogue among places of worship. Some will

have to work with patristic scholars seeing how the Church Fathers were wrestling with Aristotle, Plato and their successors over matters of what we now call science. Some will find it more than enough to re-work Philoponus' critique of Aristotle. Others will want to join the theological re-assessment of where his concepts foreshadow fundamental changes in the later history of science. Others again will seek to evaluate his indirect mediaeval influence, or the effect of his rediscovery in the Renaissance period on the following scientific revolution. All will contribute towards a radical revision of the ideas dominant in the first flush of science history as a new discipline.

Without this research by the historians of science themselves the present vested interests[41] will remain in control, misleading courses will continue at both secondary and tertiary levels, using textbooks equally misleading and out of date, and modern Western culture will continue without scholarly examination of the relations between science and the Christian religion. All cultures are a mixture of truth and error; Western culture is no exception. Its recent history and current problems suggest that it embodies some fundamental errors. After the collapse of the secularization thesis governing its future there is a growing sense that there may be something seriously wrong at the intellectual and spiritual foundations. This is where the cultural fundamentals of science and religion meet, and where truth in each sphere involves the truth about their relationship. In this paper I have described my own intellectual journey of discovery towards this truth, the true relation between science and the Christian religion.

Support for threatened science

In the concluding chapter of *The Roots of Science* I described this relation as a partnership involving mutual fertilization and mutual support. I have indicated, however sketchily, something of the fertilization provided by the theologies of Philoponus and of Faraday and Maxwell for their scientific work, and I am sure we could explore this process in the reverse direction also, not only historically but also in the present. Professor Torrance has raised this possibility between the renewed studies of the intra-relational Trinity and the problems associated with quantum theory, and it seems that much more positive relations between science and theology lie ahead[42].

The first public attack on science in modern times appeared in the 1960s counter-culture, but insofar as this was a rejection of scientism it had some justification. Now the threat to the freedom and integrity of science

comes from deeper cultural levels, from the current postmodern replacement of truth with cultural constructs. One example attempts to revive the cultures of indigenous tribal peoples and to revert to a re-spiritualized, re-sacralized view of the universe akin to animism[43]. When multiculturalists talk of "Maori spirituality" and of "Maori science", by implication they dismiss modern science as a merely Western cultural product, suited only to the needs of ethnic Europeans and true only for them. This is multiculturalism as commonly understood and presented so aggressively in Western societies. Scientists usually don't know how to defend their very existence against this move to set back the clock nearly three millennia, to the tribal worlds before the time even of the first Greek thinkers. In discussing the roots of science we are not dealing with some small and specialized historical enquiry, but with matters utterly vital to the future of the contemporary world, including especially the integrity of science. For this there is no stronger support than a right understanding of its own history and so discovering where its allies lie, in the Judaeo-Christian theology in which it was born.

The visible relation between the two on the surface of history in events such as the Huxley-Wilberforce debate or in the current "creation science" antagonism can be misleading in its changes and discontinuities. Their inescapable relationship is found in their common allegiance to the one truth about the one and the same universe. This truth remains anchored in the ongoing realities of both creation and its Creator, with a continuity transcending the discontinuities of our histories, unaffected by historical gaps even of a thousand years. Understanding this, both scientist and Christian believer can face whatever the future holds with what Lesslie Newbigin has called "a proper confidence"[44].

---

[1] See my *Frames of Mind: A Public Philosophy for Religion and Cultures*, Auckland: The DeepSight Trust, 2001.

[2] *The Roots of Science. An Investigative Journey Through the World's Religions,* Auckland: The DeepSight Trust, 1998.

[3] *Ibid* pp.43-48.

[4] *From Temple to Meeting House. The Phenomenology and Theology of Places of Worship.* The Hague: Mouton, 1979.

[5] Copied from *The Roots of Science*, p.74. A fuller analysis appears in *Frames of Mind*, pp.157-60.

[6] I once taught an undergraduate philosophy course on Aristotle's *Ethics,* and I welcome the recent increasing interest in an ethics of the virtues (as with

Aristotle's moral philosophy) rather than the current 'culturally correct' ethics of values.

[7] For fuller treatment of Philoponus see *The Roots of Science*, pp.97-102.

[8] Charles Norris Cochrane, *Christianity and Classical Culture: a Study of Thought and Action from Augustus to Augustine*, Oxford: The Clarendon Press, 1940, p. 515. New Zealanders, and Auckland University in particular, will note the thanks given at the end of the Preface, to "Mr. R. Syme", later the distinguished classicist Sir Ronald Syme.

[9] *The Roots of Science*, p.100, wrongly stated that Philoponus saw the internal force as continuing indefinitely, whereas he had said it would fade out. This error remains as a test for the critical reviewer, as to whether or how well Philoponus has been read.

[10] Michael Wolff 'Philoponus and the Rise of Preclassical Dynamics' *in* R. Sorabji (ed.), *Philoponus and the Rejection of Aristotelian Science,* London: Duckworth, 1987, pp.84-120, especially pp.100-04.

[11] Cochrane, *op. cit.* Cochrane, however, ignored the scientific contributions of the Fathers; the history of science as a discipline had not yet made its mark. In its field, however, I regard it as one of the most important books of the century.

[12] Fritz Zimmermann 'Philoponus' impetus theory in the Arabic tradition' *in* R.Sorabji (ed.), *Philoponus and the Rejection of Aristotelian Science.* London: Duckworth, 1987, pp.121-9, quotation from p.127. The Arab transmission of the works of Philoponus is the subject of current research.

[13] See *The Roots of Science,* pp.104-5; Frames *of Mind,* pp.259-61, 266-7.

[14] E.R Dodds, *Proclus, The Elements of Theology,* 1971, p. xxviii, cited by Torrance in 'John Philoponus of Alexandria – Theologian and Physicist', in a Festschrift for Archbishop Panteleimon Rodopoulos of Salonika, described as "overdue in 1998", mimeo version, p.2.

[15] M. Clagett, *The Science of Mechanics in the Middle Ages*, Madison: University of Wisconsin Press, 1959, pp.526-7.

[16] See especially Torrance, *op. cit.* at n.14, *passim.*

[17] See Charles Schmitt 'Philoponus' Commentary on Aristotle's *Physics* in the Sixteenth Century' *in* R. Sorabji, *op.cit*., pp.210-27, at p.216.

[18] Alexander von Humboldt, *Cosmos*, Stuttgart 1847, vol. 2, pp.348-9.

[19] See M. Wolff, *op.cit.,* pp.86-88.

[20] Pierre Duhem, Preface to vol. 3 of his *Etudes sur Léonard de Vinci,* repr. in S.L. Jaki, *Scientist and Catholic: Pierre Duhem,* Front Royal, Virginia: Christendom Press, 1991, pp.224-32, especially pp.225-6.

[21] From M.R.Cohen and I.E. Drabkin *A Source Book in Greek Science* Harvard University Press 1948, pp.217-23.

[22] M Clagett, *Greek Science in Antiquity,* New York; Abelard-Schuman, 1955, pp.169-76.

[23] Sam Sambursky, *The Physical World of late Antiquity*. London: Routledge; New York: Basic Books, 1962.
[24] S.L. Jaki*, Science and Creation: From Eternal Cycles to an Oscillating Universe*. Edinburgh: Scottish Academic Press, 1986, pp.185-7.
[25] Richard Sorabji, *Philoponus and the Rejection of Aristotelian Science*, London; Duckworth, 1987.
[26] Fitzroy Dearborn Publishers, Chicago, Dec. 2000.
[27] Oxford University Press, 1957, 3rd edn.1997, p.896.
[28] I have used this philosophical framework to spell out the issue in *Frames of Mind*, Parts 5 to 8.
[29] John Hick provides a good example of the "happenstance" view in many places, e.g., in *God Has Many Names,* London: Macmillan, 1980, p.90 *et passim*.
[30] Rolf Gruner 'Science, nature and Christianity' *Journal of Theological Studies,* N.S., *26*(1), 1975, pp.55-81. "Apologetic" is a positive term in technical usage, but popularly means bias and special pleading.
[31] Geoffrey Cantor, *Michael Faraday: Sandemanian and Scientist.* London: Macmillan, 1991, p.291.
[32] This contention may have been lifted from Gruner, *op. cit.,* p.60.
[33] This essential basis for "modern" or any real science is abundantly spelled out in the "revisionist" literature, but either ignored or played down by those with a permanent mind-set against it. Cantor, however, correctly identifies this view as that of Faraday – *op. cit.,* p.121.
[34] Cambridge University Press, 1954-.
[35] *The Grand Titration,* London: Allen and Unwin (1969) 1993, p.45.
[36] *Ibid* p.216.
[37] *Science and Civilization in China,* vol. 2, p.581.
[38] *The Grand Titration,* p.37. See extended discussion of laws of nature, pp.319-30.
[39] His neglect of the Judaeo-Christian tradition is the more surprising in that he did full justice to the new Hebrew view of historical time as linear, purposeful and God-directed, with a temporal mid-point in the historicity of the life of Christ, and supported by a knowledgeable bibliography; see *The Grand Titration,* pp.286-7. For an excellent extended account of Needham's personal history and religion and the context in which he worked, see Maurice Cowling 'Joseph Needham & the history of Chinese science' *The New Criterion 11*(6), 1993, 14pp., available online.
[40] All this is explored in my *op. cit., From Temple to Meeting House,* especially in ch .7 and at pp.125-8.
[41] I use this term because those in the history of science have obviously invested a great deal – in their libraries, the courses they have laboured to produce, their publications and indeed their careers. If my thesis is rejected on account of the revisions required it would mean that the history of science had been turned into

an ideology at these points.

[42] See further in *The Roots of Science* pp.172-6, and *Frames of Mind* pp.275-6.

[43] This language and this relativizing, postmodern constructivist philosophy appear in the national syllabi for all subjects produced during the 1990s by the New Zealand Ministry of Education. This body is immune to criticism and so innocent of scholarship that I cannot hope for debate with the thesis of this book. As a New Zealander I am ashamed before my colleagues overseas in the disciplines in which I have worked. See further in M.R. Matthews, *Challenging N.Z. Science Education* Palmerston North: Dunmore Press 1995.

[44] Lesslie Newbigin, *Proper Confidence, Faith, Doubt and Certainty in Christian Discipleship.* Grand Rapids: Eerdmans 1995 –- his epistemology.

To Render Praise: Humanity in God's World

based closely on a paper originally presented at the
Consultation on Environmental Stewardship, Windsor Castle, September 15-17th, 2000

Murray Rae

Festschrift 'Science and Christianity'
to honour Harold Turner and John Morton, Auckland 01-4-21.

At the conclusion of the February 1999 consultation on 'A Christian Approach to the Environment' sponsored by the John Ray Initiative, a number of themes were identified for further discussion. In his summing-up of these themes, Sir John Houghton wrote:

Some thought that the word 'stewardship' tended to be too anthropocentric and to create a misleading impression regarding our relationship to the environment — although most seemed to agree that it was the best word available. More specific questions relating to stewardship are: what human activity is carried out for the sake of Creation; what did God intend when he instructed humans to care for Creation; is it not possible to argue that the rest of Creation would be better off without humans? Further, how is the 'image of God' apparent in the relationship of humans to Creation? Can we formulate God's purposes for Creation which are at the basis of our stewardship?[1]

In seeking to explore these themes further in the present paper I propose first to make some preliminary remarks about the concept of stewardship; second, to offer a necessarily brief outline of the Christian doctrine of creation; third to elaborate in a little more detail the particular purposes of God in creation and redemption; in the light of which, finally, I shall attempt to consider how we may conceive the relation between humankind and the created order of which we are a part. In this final section, we shall revisit the concept of stewardship and consider some of the other models for that relation which have sometimes been put forward.

I Preliminary remarks on the notion of stewardship

Although the concept of stewardship has been subjected to quite harsh criticism in some quarters[2], recognition ought to be given to the worthy intentions which have sought expression through this concept. In the first place, we should have no hesitation in approving as a model for humanity's relation to the created order the preference for stewardship over exploitation and domination. While Lynn White's influential allegation that Christian theology must bear the primary responsibility for the modern ecological crisis has been shown to be superficial in several important respects, his claim is nevertheless salutary insofar as it draws attention to Christian collusion at least in the domination and exploitation of our environment. By way of correction, contemporary usage of the term stewardship clearly suggests that humanity has a duty of care for the environment and is not to regard it as a mere commodity at its disposal. Clare Palmer's contrary suggestion that because the idea of stewardship originated in a society based on slavery or serfdom it represents a despotic & autocratic form of government[3] seems to me to neglect the fact that the meanings of words do evolve over time, both shedding old connotations in the process and taking on new ones. Palmer further argues that "the political message encoded in stewardship is one of power and opression; of server and served"[4], but I would judge that in contemporary usage the ideas of care and responsibility are much more readily associated with the concept of stewardship than the negative associations Palmer proposes.

A second positive aspect of the notion of stewardship is the implication contained within it that the environment is not to be cared for by human beings simply out of self-interest. Stewardship is usually exercised on behalf of some other party. When asked, therefore, on whose behalf we are to be regarded as stewards of the creation, Christians may give the answer first that it is on behalf of God who has entrusted creation to our care, and second that it is on behalf of the creation itself. Humanity has the capacity, frequently indulged, to destroy that which is the good creation of God. The notion of stewardship on behalf of the creation may hint therefore at a responsibility to let the creation be itself[5] . Conversely, and this is a criticism of the notion that has been made by some, stewardship may suggest far too paternalistic a relation to the environment as though it somehow needs our intervention and management in order to be what it is[6]. At this stage we simply note this concern, and will return to it below.

The third party on whose behalf we may act as stewards is our neighbour, most especially our impoverished neighbours who have often been the victims of first world exploitation of the environment[7] , but also our neighbours of future generations to whom we must hand on, still as blessing, that which has been provided as blessing in God's good creation[8] .

In both these aspects then — the emphasis upon the duty of care and the suggestion that such duty is held in trust from God for the sake of creation itself and on behalf of others — stewardship serves as a suggestive if not completely unequivocal model.

We turn now however to a rather more problematic aspect of the term. In much Christian literature advocating the use of stewardship as a model for humanity's involvement in creation, I detect a fondness for the secular serviceability of the term. The term has proved useful in broader discussions involving people outside of biblical faith. This perceived strength, however, may also be a weakness, for what the term especially lacks is any explicit theological reference. That may be useful in not immediately alienating those who share a concern for the environment but do not share the biblical faith, but that supposed advantage may very well tempt us to portray, unwittingly perhaps, the theological content of our concern no longer as foundational but as an optional extra to the basic stewardship model. That, I think, is a very grave danger, the avoidance of which is the main burden of this paper.

Let me explore this weakness a little further before seeking to redress it. I have mentioned that the notion of stewardship carries no explicit theological reference. In particular it gives no indication that, whatever responsibility humanity might carry for the creation, it does not bear this responsibility alone, but rather as the covenant partner of God. The notion of stewardship, on its own, however, gives no indication that God is involved with his creation. It offers no safeguards against the faults, too often evident in Christian tradition, of divorcing creation from redemption, of conceiving God's relation to the world in merely deistic terms, and, what amounts to the same thing, of failing to conceive of the relation between God and the world in Trinitarian terms. It is possible in elaborating the model of stewardship that God may be referred to as the Creator and as the one who has set humanity in its place as steward of creation, but the term itself does not make it apparent that God and not humanity is the one who sustains and preserves creation and directs it toward its fulfilment. It will no doubt be the case that Christian

advocates of the model of stewardship will want to thank God for what he has given us to be steward over and enjoy[9] , but what reason is there to believe that even this reference to God is any more than an optional extra for the pious?

None of these faults, to be sure, are *entailed* by the use of stewardship in the context of environmental ethics, but they are potential and perhaps even probable faults if our understanding of stewardship is allowed to float free of a proper theology of creation and redemption. It is to the task of outlining the rudiments of such a theology, then, that we now turn.

II Creator and creation: God's relation to the world

In the account of God's creation of the world provided to us in Genesis chapter 1, it is said, and several times repeated, that the creation is good. It is important to note, however, that this is not humanity's verdict but God's. In the world as it now is, the goodness of creation does not yield itself unambiguously to human inquiry. The notion of the goodness of creation is, therefore, an article of faith. It is affirmed theologically as an act of trust in God's word. That this must be so is apparent when it is understood that goodness is a teleological concept; it is necessary to ask the question of anything good, 'good for what?' Some notion of purpose is essential to understanding in what this goodness consists. The biblical view is that creation is good by virtue of its being suited to God's purpose. Creation is the suitable means for bringing about God's intention of a particular form of relationality between himself and the world, expressed in its divine-human dimension as covenant love. Creation is thus a project in progress under the blessing and promise of God. That it is God's project and not humanity's is thus the first theological principle that distinguishes a biblical conception of humanity's relation to the environment from other accounts of that relation. And this distinctiveness is of course of the utmost importance. It will both provide a very particular motivation for the care of creation and dissuade us from the temptation to believe that everything depends on us. Ironically, it is just that latter belief that is often urged upon us by those who are otherwise adamant that anthropocentricity is the first evil to be overcome in the present ecological crisis[10] . Christianly conceived, however, the ecological crisis does not call, in the first instance, for more concerted human activity, notwithstanding that it is our activity by & large that has created the problem in the first place. The overcoming of the disorder which now mars the creation is not simply a matter of human invention and determination. A patient and prayerful waiting upon the

Lord is equally part of the human responsibility in relation to the created order — alongside various forms of activity. There is a theological reason for this warning against the human presumption that we can fix the problem. It is that stated by Christoph Schwöbel who writes:

... the preservation or restoration of creation cannot be a human task if this creation is continuously created and preserved by God who brought it into being in the first place. Theologically, creation, including the sustaining and preserving of creation, is a divine and not a human work.[11]

However we shall develop it therefore, a Christian ecological ethic will not presume that the preservation and sustenance of creation is a feat of human prowess, but will rather understand human care for the environment as an obedient co-operation in the purposes and work of God. Conservation, meaning a co-operative service, is thus the proper human responsibility, while creation and preservation are the undertakings of God alone.

Here we may bring to bear another principle of the biblical understanding of creation, namely that the divine act of creation takes place *ex nihilo.* The creation is brought into being by God 'out of nothing'. This means, in contrast with Greek conceptions of the matter, that the material world is neither eternal nor has any necessary existence. It is a contingent reality and, as John Zizioulas has pointed out, 'it contains in itself no guarantee of survival'[12] . It has, in other words, no capacity to sustain and preserve itself. Its survival, Zizioulas further explains, depends on its being 'in communion with what is not world by nature ... namely God.'[12] That communion is precisely what has been disrupted by humanity's fateful decision, constantly renewed, to go its way in defiance of the Creator. The ecological crisis is but one of many symptoms of this breakdown in relationality between creation and creator. Just as human beings are the primary cause of creation's having been brought in this way into bondage to decay, so their redemption and reorientation to God are an essential pre-requisite of the whole creation's being restored to its true relation to God and set again upon its divinely given trajectory of fulfilment. The ecological aspect of this redemption is that humanity is enabled again to enjoy and use the creation in the ways that God has given it to be used and enjoyed.

While we have been speaking above of the 'created order', we have also had cause to refer to the disorder which now mars the creation. Here

there *is* a self-evidence attending the claim that is being made, although its root cause is again not discernible apart from the disclosure of God's purpose. We speak of course of the reality of evil, and in particular in the present context, of that evil which strips creation of its blessedness, rendering it inhospitable to the living creatures of God's fashioning and scarring its beauty with the imprint of human greed and exploitation. Deriving from the fact that human beings are set in the creation, not as already perfected beings but as enabled to grow up in love for the creator, and in harmony with his creation, it is possible that we may *not* grow up in that loving and harmonious relation but turn away from it. The point has been ably expressed by Douglas Farrow who comments as follows on Irenaeus' contention that Adam as first created by God was imperfect:

The 'imperfection' is this: the love for God which is the life of man cannot emerge *ex nihilo* in full bloom; it requires to grow with experience. But that in turn is what makes the fall, however unsurprising, such a devastating affair. In the fall, man is 'turned backwards'. He does not grow up in love of God as he is intended to. The course of his time, his so-called progress, is set in the wrong direction.[13]

We have to do here with the thwarting of the purpose of creation, with the erection of barriers in the way of the realisation of God's purpose. What is commonly called the ecological crisis is a theological problem at root because it is the disruption of God's ordering of things. It betrays a lack of attention to, indeed wilful disregard of, the divinely bestowed goodness of creation. The result, of course, is not good, but evil. That the problem is theological at root means also that there must be a theological basis for its overcoming. About this too, we shall have more to say in due course.

The second point following from the recognition that creation is God's project is that we are concerned here not only with what is, but also with what will be. Creation is not simply something given to sustain humanity in the present. It is not to be regarded as a transient home for the temporarily embodied human soul, ultimately to be left behind when the *dis*embodied soul returns or progresses to some spiritual realm after death. This is the Gnostic error which has been repeated all too frequently in the Christian tradition[14]. The biblical view, in contrast, consistently held throughout Old and New Testaments, is that not merely the human soul but also the material creation itself has a future. The vision of the book of Revelation of a new heaven and a new earth

summarises the hope articulated throughout the Bible that, far from treating the material world as a cast-off in the process of the human soul's redemption, God's purpose is to redeem the world as a whole, to establish within it and in relation to himself that harmonious co-existence of all that he has made. The prevalence in the Bible of images incorporating the non-human creation is a striking feature of this eschatological vision. In Isaiah's vision of the peaceful kingdom, for example, it is proclaimed that 'the wolf shall live with the lamb, the leopard shall lie down with the kid, the calf and the lion and the fatling together, and a little child shall lead them' (Isaiah 11:6). What is the reason for this harmony? Isaiah explains in v9 that 'they will not hurt or destroy on all my holy mountain; for the earth will be full of the knowledge of the Lord as the waters cover the sea'. If we ask further how this knowledge of the Lord has arisen, then the answer is supplied in the opening verses of the chapter. 'A shoot shall come out from the stump of Jesse, and a branch shall grow out of his roots. The spirit of the Lord shall rest upon him, the spirit of wisdom and understanding ...' (vss.1-2). Isaiah's vision of the kingdom of God is set within the context of his hope for the coming Messiah.

The remarkable consistency of this vision across the vast variety of the biblical witness is evident again when in the prologue to John's gospel it is proclaimed that the Word became flesh. In the incarnate life of Jesus Christ, the Word of God and second person of the Trinity graces material reality with his own presence thus confirming its goodness, and showing it to be object of God's loving purpose. In Jesus Christ, God's relation to the world takes the form of his becoming a subject within it. The one through whom and for whom all things were created and hold together (Col. 1: 17) renews through his presence that which human sinfulness had subjected to disorder and decay and 'reconstitutes it in its relation to God'[15]. The pneumatological dimension is crucial here. Just as it is through the Spirit's agency that a body is shaped for Christ in Mary's womb, thus enabling, as Colin Gunton has put it, '*this* part of earth to be fully itself, to move to perfection rather than to dissolution'[16], so too the Pentecostal pouring out of the Spirit upon the world completes Christ's action in redirecting the world to its destiny in communion with God. The Irenaean metaphor of the Son and Spirit active in creation as the two hands of the Father is appropriate again here as that divine creativity is redemptively exercised in redirecting the fallen creation towards its intended fulfilment.

This makes a Christian concern for the environment an essentially christological and pneumatological matter. It is only in Christ and

through the power of the Spirit that the created order is enabled to become what it is purposed to be. It confirms too, the point already made that so far as humanity's being in the world is concerned we are reliant first of all not upon human prowess, nor even upon a more faithful stewardship, but rather upon the forgiving, redemptive and revitalising love of God. It is only because God does not abandon his creation that there is a hope and a goal for which we may strive with all our energy and ingenuity.

This soteriological theme alerted the writers of the New Testament to the fact that Christ and the Spirit are related to the created order, not merely as the agents of a rescue operation when it has suffered the disruptions of human sin, but as those through whom the creation has come into being and is sustained in being. Thus the author of Colossians writes that "in [Christ] all things in heaven and on earth were created", the letter to the Hebrews proclaims that Christ "sustains all things by his powerful word" (Heb. 2:3), and in Pauline writings particularly the Spirit is identified as the one who "gives life". Or again, the Word that became flesh as announced in the opening proclamation of John's gospel is the Logos, "through whom everything was made and without whom nothing was made that was made" (John 1:3). Though not consciously Trinitarian in their articulation of the matter, the Old Testament writers too wrote that the creation was brought into being by the utterance of God's Word and is enlivened & sustained by God's having 'breathed' into it his own *ruach* or spirit. The creation quite literally owes its life to God, not just in its beginnings but in every moment that it draws breath. Apart from God, therefore, the creation dies.

The Christian celebrations of Christmas and Pentecost may thus be seen as critical to the doctrine of creation, for in those feasts it is recognised that God who is other than the world is nevertheless not remote from it. The Creator has not left the world to its own devices but rather manifests his love for it both by becoming a subject within it for the sake of its redemption and by filling it anew with his Spirit so that it is preserved and renewed in its capacity to bring forth life. We should understand 'life' here to mean not mere existence but that fullness of creaturely being which is realised in communion with the Creator, and which yields as its consequence the restoration of a proper relationality amongst God's creatures. It is of the greatest significance that among the first gifts of Pentecost are speaking in other languages and koinonia, both of which abolish the barriers that have divided people from one another. It is the Spirit of God who is responsible for this reconciliation and is responsible

too, as the Bible elsewhere affirms, for the renewal & revitalisation of the non-human creation as well. In Ezekiel 36, for example, God's promise to pour out his Spirit upon Israel is accompanied by a renewing of the abundance of the grain and the fruitfulness of the tree. Significantly for our present theme, Ezekiel insists that this renewing of the fruitfulness of the earth should provoke the people of Israel to remember and repent of their evil ways[17]. Significant too is God's further admonition that it is not for Israel's own sake that he will do these things. Is it then for the sake of the earth itself that God reverses these consequences of human sin? If this be the case then it is right to resist that form of anthropocentricity which regards the creation as being nothing other than God's provision for humankind. Theologically we are bound to see that the non-human creation is brought into being by God, not only as blessing for humankind but also for its own sake.

The passage from Colossians 1, already quoted, which looks to Christ as the one through whom all things were created and hold together, affirms too that "through him God was pleased to reconcile to himself all things, whether on earth or in heaven, by making peace through the blood of his cross" (Col.1:20). The redemption wrought here, the reconciliation won and the peace established, does not refer simply to human beings but to 'all things, whether on earth or in heaven'. The distinctiveness of a Christian approach to ecology is nowhere more apparent than in this affirmation. If there is hope for our world, if the promise of a harmonious co-existence of all created things is to be fulfilled, if a peace may be found which gives to each created being the capacity to be fully realised as that which it was purposed to be, then this will be because of Christ, and more particularly, according to Colossians, because of the blood of his cross. How shall this be understood?

Between Christmas and Pentecost, mediating the transition, lies Holy Week and Easter. Here most especially God's love for his creation is made apparent. Through the trials of Gethsemane and his death on the cross at Calvary, the son of God, through whom all things were created and hold together, exposes himself to the reality of this world's dissolution, drains once and for all time the cup of bitterness that has been filled to overflowing with human treachery to God and his creation, and thus ensures that not even the worst that humanity does can thwart God's purpose of communion with all that he has made. If death means the same thing as a life alienated from God, as a life exhausted of the Spirit's breath, then in submitting himself to that death the Son of God,

by virtue of the fact that it is he who suffers these things, robs humanity of its power to render the world Godless, and saves us thus from the dread consequence of our sin. Or to put it in the language of John's prologue; the term 'Logos', used there of Christ, signifies the reason and order of the universe. He is the world's reason for being and the one who gives it its order and intelligibility[18]. That this Logos, therefore, should confront on the cross humanity's tragic efforts to foist upon the world an order of its own making and to wrest from God, by crucifying his Son, the prerogative to preserve the world and guide it to its fulfilment — that Christ should confront this evil at the greatest depths to which it may sink, establishes and confirms his sovereignty at the point of humanity's most profound rebellion against it. What this means is that the world is not finally in our hands but in God's. This does not mean that we have not been called to care for it. Indeed we have, and we remain capable of abusing that trust. We remain capable of making a hell out of that which has been created for good. But we are not capable of defeating the steadfastness of God's love for the world, for even where we do our worst, God is to be found there, in the crucified figure of Jesus, gathering together in himself all things in heaven and on earth, and preparing them for that day when all things will be completed and presented to the Father.

Here again the distinctiveness of the Christian understanding of things is readily apparent. The kingdom of God is not yet, and disbelief has evidence upon which it can base its claims. So the faith of which we have been speaking, as also the act of redemption itself, is yet an anticipation of things hoped for. The work of Christ does restore God's project, and does rescue the creation from its unfaithful stewards, but it requires us still to wait for and work towards something that is not yet.

Such hope and work is founded, however, upon that further aspect of Christ's encounter with evil not yet brought to bear, namely his resurrection and ascension. The victory over chaos is not accomplished solely through the presence within it of the Logos himself, but also through God's raising to new life the one whose faithfulness to the world had taken the form of suffering love within it. The chaotic human arraying of things is robbed thus, not only of its Godlessness but also, and concomitantly, of its bondage to death. The resurrection of Christ, the *first born* of a new creation, is the beginning and condition of the transformation towards fulfilment of the whole of God's creation. And Christ's ascension to sit at the right hand of the Father in glory, confirms, once and for all, this Logos and not our own as the Word by which the world will be upheld.

III The purpose of God

Although we have given attention already to the purpose of God in creation and redemption, I propose briefly to reiterate and elaborate that theme before seeking clarification, in our final section, of how precisely we ought to conceive the relation of humankind to the outworking of God's purpose for the created order. We have suggested above that to pronounce the creation good is to affirm its suitability for the bringing about of God's purpose. God's purpose, it was further argued, is to bring about a particular form of relationality between himself and the world. It is an insight of the Trinitarian understanding of God that the form of this relationality is not arbitrary but is connected to and is indeed constituted by God's own being as love — the mutual love of the three persons of the Trinity. The project of creation, the giving and fulfilling of creaturely life, while not necessary to God[19] , may be understood as an event of God's being for the other. It is the expression and outworking of who he truly is as love, for the sake of that which he is not.

In this way the creation is an event of God's glory. In creating that which is other than God and in giving to that 'other' the freedom to love him or not, God shows forth his glory as the one who is love, who loves, and who is worthy of love. It is proper to say therefore that the purpose of creation is to show forth God's glory, but it must immediately be noted that this is not an exercise in self-gratification. The glory of God is shown forth in God's love for the other. There is no more profound statement of this truth than that which is developed through the course of John's gospel: in the prologue, John writes "The word became flesh and dwelt among us, and we have seen his glory" (John 1:14), but as the gospel unfolds it becomes ever more apparent that the glory is manifest most clearly in Jesus' 'hour' upon the cross. It is here, most especially, that creation is rescued from its efforts to thwart God's purpose. And it is here, most especially, in giving himself utterly for the other, that the glory of the Lord is revealed.

Christoph Schwöbel has correctly pointed out that if the glory of God is the proper end of creation, then 'the utility of creation for humans may never become the ultimate objective of human interaction with creation'[20] . The creation of which they are a part is undoubtedly 'of use' to human beings just as in its complex interrelationality all the parts of creation are mutually 'of use' to one another, but this mutual interdependence enabling the creation to be what it is, is directed ultimately towards the glory of God, or to put it another way, it is directed towards the realisation of that harmonious communion of love which is the reflection of God's own being. 'To the glory of God' then defines a

direction for our human action, both in respect of interpersonal relations and in our relation to the environment, which is radically different from the satisfying of our own desires at the *expense* of the other[21] .

This quest for communion may otherwise be described as the rendering of praise to our Maker. Participation in that form of relationality which we have been describing is an act of grateful agreement with the Creator's purpose. It is a response of love and an offering of the creation back to the Father in acknowledgment of the fact that it is precisely by virtue of its relation to God that the creation can be called good. The Evangelical Declaration on the Care of Creation which appeared in1994[22] thus says that it is humanity's task to 'offer creation and civilisation back in praise to the Creator'. Here we find not a particular environmental ethic or policy but an ethos and a goal within which and towards which our habitation of the world must be directed.

Although this reconciliation with God is cosmic in its scope, embracing and drawing together the whole creation, the Bible makes clear, as is reflected in the Declaration, that humanity is called upon to exercise a unique responsibility in the creation's relatedness to the creator. It is human beings who are created in God's image and human beings who are called by God to exercise dominion over all the creatures of the earth. It is through humanity too that the relation of love between Creator and creature may come to expression, for it is the human being whom God addresses in the garden and who is expected to be the responsive voice of the creation to the loving call of God. There is thus an ecological responsibility bestowed upon humanity which is called to act on the creation's behalf. In confirmation of this, though disastrously so, the first ecological crisis comes when humanity chooses to pursue an alternate plan — when it answers the call of the serpent and evades the call of God[23]. It is characteristic of the biblical world-view that this human disobedience should be seen as a crisis for the cosmos and not just a crisis for the human soul. It is humanity's exploitation of the fruit of the earth for its own ends and against the command of God that instigates the crisis and is the disruption of God's ordering of things. Thus instead of giving glory to God and offering the response of praise to its Maker, the whole creation groans in travail (Rom. 8:22), awaiting the fulfilment of God's purposes.

The question then becomes, does God abandon the creation to its travail? Has God left the world to its inevitable decline? James B. Torrance describes well the action of God in response to humanity's failure:

The good news is that God comes to us in Jesus to stand in for us and bring to fulfilment his purposes of worship and communion. Jesus comes to be the priest of creation to do for us men and women, what we failed to do, to offer to the Father the worship and praise we failed to offer, to glorify God by the life of perfect love and obedience, to be the one true servant of the Lord. In him and through him we are renewed by the Spirit in the image of God and in the worship of God in a life of shared communion.[24]

Here again, the overcoming of the cosmic catastrophe is seen to depend not first of all upon our own action, but rather upon the covenant faithfulness of God. Both communion with God and creation's response of praise are fulfilled and enabled by the action of God himself through his Son and Spirit. Hovering once more over the chaos, the Spirit redirects the world towards its unity and *koinonia* in Christ who offers it in turn to be perfected as the loved and loving creation of God. Drawing from the letter to the Hebrews (Heb.8:2), Torrance goes on to speak of Christ as our *leitourgos* , the leader of our worship and the one who fulfils on humanity's behalf the role that it was called to exercise on behalf of all creation.

This does not mean, of course, that the communion is already fully restored or that paradise has been won. The evil of discord and exploitation continues to scar the world inhibiting its praise and masking the glory of God. But in Christ and through the Spirit the world is set again on its path towards fulfilment, a fulfilment which is anticipated wherever human people meet in worship, and most particularly in the eucharist where the fruits of the earth are offered back to God, and the communion wrought through the death and resurrection of Christ is celebrated in thanksgiving and in hope[25].

We have spoken several times of creation's being brought to fulfilment, and we have defined this fulfilment in terms of the re-establishment of the communion for which the world was made and the harmonious co-existence of all its parts. It is important to make clear that this communion does not describe some static state but is rather a dynamic relationality in which the world is able to flourish and be fruitful according to God's good design. We learn from Genesis that the earth was appointed to 'bring forth fruit' (Gen. 1:11), and further, that the cultivating of this fruitfulness is a responsibility of humankind (Gen. 1:28, or more plainly, Gen. 2:15). This is not to say that the earth cannot

bring forth fruit on its own account — the earth's fruitfulness precedes the creation of humankind, both in the Genesis account and, obviously, in fact — but cultivation enables the earth's fruitfulness to be directed to a particular purpose, namely the realisation of its character as blessing, for animals and for humankind, and that flourishing which is evident in a garden not overcome by weeds but cultivated so as to show forth the beauty of each plant according to its kind. This form of letting the creation be itself does depend on human care and serves the end of rendering praise to God[26]. An important ecological principle therefore, that ought to guide Christian decision-making, is the safeguarding and enhancement of the earth's fruitfulness, especially as that is understood within the dual scope of God's blessing of creation and the rendering of praise to the Creator.

There is one final point to be made concerning God's purpose for creation before we turn to a fuller consideration of the particular role that humanity may play in the working out of that purpose. The disorder brought about by human sinfulness is of such devastating consequence that nothing short of a new creation is required in order to overcome its tragedy. This means that the world in its fallenness stands in need of a miracle. Its regeneration cannot simply be a natural process and in so many respects the disruptions of sin have wrought a chaos that exceeds humanity's power to put right. What Christianity proclaims as a matter of faith and hope however, is that the miracle has taken place. With the raising of Jesus from the dead, the creation has in the part of Jesus own material humanity been restored to life with the Father. It is for this reason that our hope for the world consists in its being gathered together in him[27] . That communion with the one through whom the world was made and in whom all things hold together is the only basis upon which all things will be made new (Rev. 21:5). In turning now to a consideration of humanity's relation to 'all things' in creation, our task must be to seek clarification of the ways in which our being in the world and responsibility towards it may serve and celebrate that christocentric purpose.

IV Humanity and the created order

Uppermost amongst the concerns of this paper is whether the relation of humanity to the natural world is helpfully described in terms of the model of stewardship. Two other models, however, also present themselves for consideration: that of dominion and that of priesthood. In this final section we shall give our attention to each of these three, asking

in particular whether they cohere with and appropriately designate the role of humanity in the theology of creation as we have outlined it above.

Dominion

It would seem useful to begin with the notion of dominion, first because, under the influence of Lynn White especially, it is this notion that has sometimes been blamed for our current ecological problems, and second, because dominion is the model suggested in the first account of creation in Genesis, we cannot simply ignore it or cast it aside. We begin, however, by acknowledging that dominion appears to be the least promising of our three models for the relation between humans and their environment. Many would follow Lynn White in suggesting that humanity's pretensions to dominion over the created order are precisely the problem. It is humanity's exploitation of the environment in service of its own ends, and its destructive carelessness of species and habitats which have led directly to what is now called a crisis in the ecology of creation. Dominion is read as domination and the command to subdue the earth is taken as an instruction to do with it what we will. But these are simply errors, succumbed to undoubtedly by some devout readers of the Bible as well as by those who urge the abandonment of these biblical imperatives. We have as much need to repent of our hermeneutical waywardness as of our ecological sins. For what is ignored most especially in this misreading of 'dominion' is the Christian conviction that dominion or 'Lordship', if we may translate the term, receives its proper definition in the one who is confessed as Lord by the writers of the New Testament. The eternal Logos and second person of the Trinity, through whom all things were created and hold together, exercises his Lordship by becoming a servant in the midst ofcreation, by directing his ministry towards the reconciliation of all things to God, and by offering his own life as a sacrifice of atonement for all that mars God's good creation. This is what dominion means when it is exercised by the Lord himself. In this light the suggestion that dominion means exploitation and domination couldn't be further from the Truth. Christianly understood, humanity's own exercise of dominion is not the imposition of our own rule upon the creation but a faithful following after the order that is established by Christ. Servanthood, reconciliation and self-sacrifice become the distinctive marks of humanity's dominion exercised in faithfulness to God. Because of its truthful orientation to the pattern of God's own dominion of creation in Christ, such human action, seen first in Christ himself, may be conceived in this way as an act of worship, a rendering of praise to God in respect for and glad agreement with God's own purposes.

Priesthood

A second model for conceiving humanity's responsibility toward the creation is priesthood. Favoured especially by theologians of the Eastern Orthodox tradition, this model suggests that humanity is the priest of creation. The key elements of this model are blessing and offering. Created in the image of God, humanity is called to continue God's blessing of creation, preserving its beauty and nurturing its fruitfulness. It is called upon also, however, to act as the priest who offers back to God that which has come originally from God's hand. In expounding this notion, Vigen Guroian cites the example of Noah who at the conclusion of the flood story built an altar to the Lord and offered burnt offerings there of every clean animal and of every clean bird. God's response is to preserve the blessing of creation and never again to destroy the living creatures as he had done in the flood. Noah's priesthood, his offering of the creation back to God, became the reason why creation itself was to be preserved[28]. It is tragically the case, however, that humanity has generally failed in this task of priesthood. Only in Christ is our human responsibility once and for all fulfilled. This means that God's covenant commitment to the creation is secure. He will never again turn against it nor abandon his purpose of bringing it one day to the fulfilment of reconciled relationship with himself. What is in doubt, however, is how long humanity will continue to rebel against this purpose, how long humanity will, in its reckless disregard of the creation's blessedness and order, impel creation towards the brink of chaos. The question remains open how much havoc we will wreak before we consent to the offering of creation back to God made on our behalf by Christ. In the meantime the Christian celebration of the eucharist, the taking of bread and wine, 'fruits of the earth and the work of human hands' as one liturgy puts it, is the memory of a priesthood fulfilled, the celebration of the continuing intercession of Christ on our behalf, and the anticipation of things hoped for in the feast of the kingdom of God[29]. Again this liturgical action suggests a pattern for ecological responsibility. The things of earth are to be handled with thankfulness that they are indeed a blessing, and their use by humanity is to be directed towards the purpose of communion among the creatures of the earth and a worshipful reconciliation with God[30].

Stewardship

We return finally to the concept of stewardship. How well does it serve as a model for humanity's ecological responsibilities? The key criticism levelled against it at the beginning of this paper was that on its own the model of stewardship provides no check against a deistic conception of

God's relation to the world. It offers a conception of humanity's task without explicit reference to the theological context of Christ's creative and redemptive agency. Christianly conceived that would be a serious fault but it is certainly not the case that all Christians who employ the concept of stewardship do so in disregard of the christological themes we have been elucidating. The question to be addressed, therefore, is whether under the umbrella of these wider theological considerations, stewardship might serve a useful role. We have seen already that writers such as Clare Palmer are sceptical about that. Palmer, probably correctly I think, finds little explicit reference in the Bible to the idea that humanity is the steward of creation. She also argues that the association of stewardship with the culture of slavery renders it particularly unsuitable for use in a Christian context. I have already suggested, however, that Palmer takes insufficient cognisance of the way words are subject to a degree of semantic transformation over time, and I doubt very much that the oppressive associations she evinces for the term are those most readily called to mind today. Be that as it may, I propose that the recovery of an ethos of servanthood and obedience is precisely what we do need in order to make a better fist of our ecological responsibilities.

Let me develop this idea with reference again to John's gospel, and in particular, to an occurrence of the idea of stewardship that is to be found within it. It is the occasion of the wedding feast in Cana, the first of John's 'signs', in which Jesus transforms water into wine. At face value, Jesus' intervention simply staves off a disastrous social embarrassment for the host; but it is clear that John intends the story to represent a great deal more than this. The narrative is rich with theological overtones. The transformation of water into wine takes place at a wedding feast. Marriage is, of course, a familiar biblical metaphor for the relation between God and his people. We are told too that the water was stored in jars for the Jewish rites of purification. The theme here evoked is atonement and reconciliation — the setting right of humanity's unfaithfulness to God. The question is, how does this miracle take place? Two factors are significant for our present theme.

It is a characteristic of John's gospel that his whole narrative builds towards and foreshadows Jesus' hour of glory when he is lifted up on the cross. That is the decisive moment of transformation of the whole cosmos. In that lifting up, in sacrifice, in obedience and in offering of the world back to God, Jesus redirects creation back towards its telos in communion with God, and inaugurates through his resurrection the promised new heaven and new earth.

The cosmic scope of this transformation is apparent too from the retrospective allusions in John's story of the wedding feast at Cana. This is not the first biblical story in which wine has dried up. In Isaiah 24 God's judgement upon human sin impacts strikingly upon the whole earth.

The earth dries up and withers,
the world languishes and withers,
the heavens languish together with the earth.
The earth lies polluted under its inhabitants;
for they have transgressed laws, violated the statutes,
broken the everlasting covenant ...

The wine dries up, the vat languishes ...

There is an outcry in the streets for lack of wine ...
— Isaiah 24: 4-5, 7, 11

The turning of water into wine through the ministry of Jesus is the overcoming of this devastation. It is the beginnings of the reversal of the cosmic catastrophe wrought by human sin[31] . It is through Christ's agency and not our own that the new creation is inaugurated and the new wine poured out in abundance. That is the first point. But the second point, bearing directly upon our concern with stewardship, is the role that is to be played by those around Jesus. When Mary, Jesus' mother, speaks to the servants at the wedding she instructs them to do whatever Jesus tells them. 'Nowstanding there were six stone water jars for the Jewish rites of purification, each holding twenty or thirty gallons. Jesus said to them, "Fill the jars with water". And they filled them to the brim. He said to them, "Now draw some out, and take it to the chief steward". So they took it.' (John 2:6-8). There is a heavy emphasis on obedience. The miracle takes place as the servants are obedient to theinstruction of Jesus. Again this is a reversal; a contrast is being made with the disobedience that, according to Isaiah, had laid the earth to waste in the first place. The stewardship enacted here is not undertaken on behalf of an absent landlord, as may sometimes be suggested in the environmental debate. Rather it is carried out in strict obedience to the Lord who is himself present and whose presence in the midst of the created order is precisely that condition by which the new creation may begin to emerge.

What will obedience to the Lord mean in practice? The story of the wedding in Cana gives us a clue also to this. We have noted already that

the story is rich with theological overtones. As well as recalling the Isaiah passage it also looks forward even more emphatically to the crucifixion and resurrection of Jesus.

In the whole of John's Gospel there are seven miracle stories, or seven signs if we are to use John's own language. By calling them signs, John draws our attention, not just to the miracles themselves but more importantly to what these events point to. He tells us of these events, he says, so that the glory of the Lord might be revealed. Seven is, of course, the biblical number signifying perfection and completion. It is the number drawn from the creation of the world in seven days. So the story John is unfolding here through the seven miracle stories, the seven acts of transformation, is nothing less than the re-creation of the world. John's seven signs reveal how the new creation isto take place and simultaneously disclose the glory of the Lord. The miracle stories, therefore, are not isolated incidents that can be left to stand each on its own. Rather, John arranges them in a chiastic structure so that they can be understood in relationship to one another[32]. The following structure is found in M. Girard[33].

(1) The wedding feast at Cana (2:1-12)
(2) The Restoration of the dying son (4:46-54)
(3) The Sabbath healing at Bethesda (5:1-16)
(4) The multiplication of loaves (6:1-71)
(5) The Sabbath healing of the blind man (9:1-41)
(6) The restoration of Lazarus to life (11:1-44)
(7) The great hour of Jesus: his mother, the cross and the issue of blood and water from Jesus' side (19:25-37)

So, for example, the central sign of the seven, the fourth sign, is the story of Jesus' feeding of the five thousand. Among other themes, we see here the divine overcoming of the inadequacy of human provision and the bountiful replenishment of the fruits of both land and sea. There is also a strong connection with Passover which in turn makes a link with signs one and seven. The six other signs are arranged symmetrically around this central miracle. Thus the third sign, which is the healing of a man on the Sabbath prompting outrage from the scribes & pharisees, is parallel with the fifth sign, the healing of a man born blind. The man's physical blindness draws attention to the spiritual and theological blindness of the religious authorities who would not tolerate a healing taking place on the Sabbath.

Similarly there is a parallelism between the second and the sixth signs. The second sign is the healing of the official's son who was close to death and the sixth sign is the raising of Lazarus. The emphasis here is on the victory of Jesus over death, culminating in the saying of Jesus, I am the resurrection and the life.

But the pair of signs which interests us especially is the first and the seventh signs. The first is the turning of water into wine and the seventh sign is the crucifixion and, I would add, the resurrection of Jesus. With the careful arrangement of his gospel John is suggesting that these two signs be understood together. But why is this? What is the point that John is making here? Let us listen again to the story of the wedding feast and note the parallelism which John constructs. John's story of the wedding begins, "On the third day there was a wedding in Cana in Galilee". On the third day. This is a familiar biblical symbol that something momentous is about to happen. On the third day Jesus was raised from the dead. The turning of water into wine foreshadows the day when, because of Jesus' resurrection, Isaiah's catastrophe, with all its destructive implications for the environment, is reversed. It foreshadows the day when all things are made new and the earth once more yields good wine which is made available to all. The earth may be renewed. The world may have wine. John is telling us how we may have it.

When the wine failed the mother of Jesus said to him, "They have no wine" and Jesus said to her, "Woman, what have you to do with me?". Only once more in the gospel does Jesus address his mother: at the crucifixion, at the time of the seventh sign. When Jesus saw his mother and the disciple whom he loved standing near, he said to his mother, "Woman, behold your son". The words "Woman, what have you to do with me?" foreshadow a time when in his loneliest hour she is one of only a very few who will still have anything to do with him. Again John is confronting us with the challenge. Is it transformation and new creation that we want? Then the question is asked of us too, what have we to do with Jesus?

In response to his mother's inquiry about the wine, Jesus continues, "My hour has not yet come". These too are words that foreshadow unmistakably Jesus' agony upon the cross. The parallels between the first and the seventh signs are carefully constructed. The transformation from water to wine is the transformation from old life to new, from a desolate withered earth to the new creation envisaged in all the biblical language about the

kingdom of God. Water will be turned to wine, the earth will be transformed but John tells us that the transformation takes place because of one who so loved the world that he gave his life for it upon the cross. That is the place of transformation; that is the decisive act through which the earth will be renewed. And that renewal depends crucially, not on human prowess, but on our obedience to the one through whom all things were created andhold together.

As we read John's account of the seventh sign we are told that in order to prevent the bodies remaining on the cross on the Sabbath, the Jews said to Pilate that the legs of the crucified victims should be broken. This would hasten death and the bodies could then be taken away. "So the soldiers came and broke the legs of the first and of the other who had been crucified with him but when they came to Jesus and saw that he was already dead, they did not break his legs. But one of the soldiers pierced his side with a spear and at once there came out blood and water" (John 19: 32-34). Blood and water, water and wine. The world may be renewed — it may have new wine. Through his evocative linking of these two signs, John is making clear how that miracle takes place.

It may appear that I have wandered far from our concern for whether stewardship can be a model for our ecological responsibility. But the point of my recalling in such detail this story from John's gospel is to emphasise the point that if we are to retain the notion of stewardship, then we must be clear that, Christianly understood, stewardship does not entail that humanity be the Lord and master of the world, even if only as deputy while the true Lord of all is absent. Rather it means obedience, to the Lord who is to be found in our midst. Like those who were obedient to his instruction at the turning of water into wine, those who would be stewards now are called upon to follow after the pattern of Jesus' life which led him to the cross. Self-sacrifice rather than selfish indulgence; the offering of all things to God, rather than the accumulation of things for one's own ends; the laying aside of power, rather than the will to dominate; the acceptance of lowliness and even suffering for the sake of the glory of God: none of these amount to rules for ecological action, but they do represent an ethos, or a Christian framework within which our stewardship of creation may be exercised in faithfulness to the author of creation himself. The biblical view is that such faithfulness has a direct impact upon the fruitfulness and blessing of the earth itself.

V Concluding Remarks

I have been attempting to outline here a theological framework within which our human responsibility for the environment may be understood. The primary point of my argument is simply that whatever language we are to use of that responsibility, be it dominion or priesthood or stewardship or anything else, that language will be filled with its proper content only in attentiveness to the action of God through Christ and the Holy Spirit. This means that, while not rejecting it, we cannot make do with a merely secular meaning of the term stewardship. To care for the earth and to accept some responsibility for its well-being are commendable virtues, but these hold no power on their own to reconcile the earth to God and to offer it in praise to its Maker.

A second point I have been emphasising is that the world is God's creation not ours, and it is God who is finally responsible for bringing the creation to its fulfilment. We human beings are graciously embraced as partners in that purpose, and our environmental responsibilities, therefore, must be worked out in faithfulness tohim.

And my third point is simply that we look forward in Christian hope, not simply to the maintenance of this present order but to its transformation. Foreshadowed and inaugurated in the resurrection of Christ himself, God's purpose is to make all things new. It is of the utmost importance to recognise that the old is not discarded. It is to be transformed. That is the ultimate basis for nurturing and caring for this present creation, for it is this world and not some other that is to take its place in the final outworking of God's purpose. It is as stewards of that hope that Christians have a basis also to be stewards of the creation itself.

---

[1] Sir John Houghton, 'Epilogue' in *Transformation: An International Evangelical Dialogue on Mission and Ethics 16* (3) 112-3 (July/September 1999).

[2] See for example, Clare Palmer, 'Stewardship: A Case Study in Environmental Ethics' in Ball I, Goodall M, Palmer C and Reader J. (eds) *The Earth Beneath* (London: SPCK 1992) 67-86.

[3] Palmer, 'Stewardship...' p.77.

[4] Palmer, p.76. We note also, however, that the idea of service (rather than slavery) need not be construed in the negative way that Palmer appears to encourage. We will say more of this below.

[5] This idea is advanced by Colin Gunton and will be explored further below. See Gunton's two works *Christ and Creation* (Carlisle: Paternoster Press 1992) and

The Triune Creator: A Historical and Systematic Study (Edinburgh University Press 1998)

[6] Richard Bauckham is among those who have raised this objection. See Bauckham,'Stewardship and relationship' *in* R.J. Berry (ed.) *The Care of Creation* (Leicester: IVP, 2000) 99-106, p.103. Oliver O'Donovan, though not specifically critical of the idea of stewardship in this regard. also warns against imagining that we must manage nature 'as if it was a pathetic dependent upon our kind consideration and foresight'. See O'Donovan, 'Where were you ... ?' in R.J Berry, *op cit.*, 90-3, p.91.

[7] This concern was recognised in the summary remarks of Sir John Houghton at the 1999 consultation of the John Ray Initiative *op cit*., p.112f.

[8] The theme of blessing in relation to ecological ethics has been developed by Vigen Guroian in *Ethics After Christendom* (Grand Rapids: Eerdmans,1994) 155-74.

[9] I owe the point to John Zizioulas. See the third of his lectures, 'Preserving God's Creation. Three Lectures on Theology and Ecology' in *King's Theological Review,* XIII. 1 (Spring, 1990) 1-5, p.4. Clare Palmer, similarly, claims that some 'perceptions of stewardship have difficulty in accommodating the idea of God's action or presence in the world. God is understood as an absentee landlord, who has put humanity in charge of his possessions'. *op cit.*, p.74. I agree with Palmer's basic point but would prefer not to imply (if Palmer does) that the idea of stewardship *entails* a deistic theology. It need not! My own view is simply that without careful qualification it fails to guard sufficiently against deism, and that it is this fault that must be addressed.

[10] In fact we shall want to make some affirmations about the importance of humanity's responsibility both for the crisis itself and for its overcoming but it will be within a theocentric rather than an anthropocentric context.

[11] Christoph Schwöbel, 'God,Creation and the Christian Community' *in* Colin E. Gunton (ed.),*The Doctrine of Creation: Essays in Dogmatics, History and Philosophy* (Edinburgh: T&T Clark, 1997) 149-76, p.150.

[12] John Zizioulas, Lecture One in the series 'Preserving God's Creation. Three Lectures on Theology and Ecology' in *King's Theological Review, XII*. 1 (Autumn, 1989) 1-5, p.3.

[13] Douglas Farrow, 'St Irenaeus of Lyons. The Church and the World', *Pro Ecclesia* 4 (1995) 333-55, p. 348. I owe the reference to Colin Gunton, *TheTriune Creator,* pp.201f.

[14] For an account of the way that Gnostic influences have frequently distorted the Christian doctrine of Creation, see, Colin Gunton, *The Triune Creator,* especially 47-50, or, more extensively, Gerhard May, *Creatio Ex Nihilo: The Doctrine of 'Creation out of Nothing' in Early Christian Thought,* trans A.S. Worrall (Edinburgh: T&T Clark, 1994)

[15] Colin Gunton, *Christ and Creation,* p.33.

[16] Colin Gunton, *Christ and Creation,* p.52.

[17] The well known passage in Joel recording God's promise that his Spirit shall be poured out on all flesh provides another instance of this close relation

between the work of the Spirit and the regeneration of the earth. See Joel chapter 2 from verse 18.

[18] It is noteworthy that both John Morton and Harold Turner in whose honour this collection of essays has been brought together appeal to the concept of the Logos and recognise its importance for the natural sciences. That the world has a rationality and intelligibility of its own, vested in it by God, is a *conditio sine qua non* of the scientific enterprise. See Harold Turner, *The Roots of Science* (Auckland: The DeepSight Trust, 1998) and John Morton, 'Conservation and Christianity' a sermon broadcast by Radio New Zealand, September 29 1991, and published in *New Zealand Environment 68* (Dec. 1991).

[19] It is an error of various forms of process theology that God needs creation in order to realise his own being. Such an error is made conspicuous by the pantheism in which it inevitably results.

[20] Christoph Schwöbel,'God, Creation and the Christian Community', p.169.

[21] The point is again drawn from Christoph Schwöbel, *op.cit.* p.170.

[22] The Declaration is a product of the Evangelical Environmental Network and is reproduced in Berry (ed.) *The Care of Creation* 17-22.

[23] See Genesis 3:17, 'Cursed be the ground because of you'

[24] James B. Torrance, *Worship, Community and the Triune God of Grace* (Downers Grove, Ill.: IVP 1996) p.14.

[25] The significance of the eucharist for the facing of our ecological problems is outlined by John Zizioulas in his 'Three Lectures on Theology and Ecology'. See Lecture I, *op cit*., p.4f.

[26] The point is made similarly by Colin Gunton who writes that humanity has a responsibility to 'be and to act in such a way as to enable the created order to be itself as a response of praise to its maker'. *The Triune Creator,* p.12.

[27] On which, see Colin Gunton, *Christ and Creation,* p.64.

[28] See Vigen Guroian, *Ethics after Christendom*, p.162.

[29] Further discussion of the eucharist as a decisive point of orientation within the current ecological crisis can be found in John Zizioulas, 'Three Lectures on Theology and Ecology', Lecture I.

[30] Richard Bauckham makes a valid point when he argues that we must beware in using the model of priesthood of intruding 'our inveterate sense of superiority exactly where the Bible will not allow it'. The creation, he says, does not need us to offer praise on its behalf. It praises God just by being itself. He further points out that the Bible offers several instances of the creation praising God without our aid. See Bauckham, 'Stewardship and relationship' in R.J. Berry (ed.) *The Care of Creation* 99-106, p.104 , and 'The New Testament teaching on the environment: A response to Ernest Lucas' in *Transformation 16* (3) 99-101 (July/September, 1999). The point notwithstanding, a particular role for humanity, vested in it by virtue of its being made in the image of God, is also an idea drawn from the biblical source. The key here, I think, is that humanity alone among the creatures has the capacity to reciprocate the love God has for the creation — to enter, in other words, into that distinctively personal form of relationality which is mutual love, and it is in this relation that the communion

between creation and Creator obtains its highest goal. Where humanity fails in this, creation as a whole suffers; where humanity succeeds through the priesthood of Christ, the whole creation is restored.

[31] Raymond Brown notes that 'one of the consistent OT figures for the joy of the final days is an abundance of wine(Amos ix 13-14; Hos xiv 7; Jer xxxi 12). See Brown, *The Gospel According to John I-XII*, The Anchor Bible Commentary (New York Doubleday, 1966) p.105.

[32] This structural analysis of John's signs was drawn to my attention by Alister Rae, unpublished sermon, May 1986. It is supported by Joseph A. Grassi in 'The Role of Jesus' Mother in John's Gospel' *Catholic Biblical Quarterly,* 48.1 (January 1986) 67-80, and before him by M. Girard, 'La composition structurelle des sept signes dans le quatrième évangile' *SR,* 9 (1980) 315-24. Note that this selection of seven signs, including the crucifixion but omitting the walking on the water, is also agreed to by John Marsh. Marsh notes too, the strong parallelism between the first and the seventh signs; see his commentary, *Saint John,* (Harmondsworth: Penguin Books, 1968) pp.65f., and 141-50.

[33] Reproduced in Grassi, op cit. p.69.

The Rebirth of Nature and the God of a Living World

Rupert Sheldrake

Festschrift 'Science and Christianity'
to honour Harold Turner and John Morton, Auckland 01-4-21.

In thinking about the relation of God and nature, much depends on how we conceive of nature. A change in our view of nature is currently coming about through science itself. We are living through a major period of change in science, a paradigm shift, from the idea of nature as inanimate & mechanical to a new understanding of nature as organic & alive. The God of a living world is very different from the God of a world machine.

For the vast majority of human existence, the vast majority of human beings have taken it for granted that Nature is alive. In our own culture people habitually spoke of Mother Nature and Mother Earth. It was taken for granted that we live in a living world. This view was held by the Jews among other ancient peoples, and also by the Greeks. The Greeks thought of the entire cosmos as a vast living organism, like a giant animal with a body, soul and spirit. And everything within the world participated in this life of the cosmos. It was what we'd now call a holistic vision. The Greeks made it more explicit than most, and it was inherited from the Greeks by the Middle Ages, particularly through the philosophy of Aristotle.

The official doctrine in the Europe of the Middle Ages was that the world was a living world. Animals and plants had souls, they were truly animate. The world was pervaded by all kinds of spiritual and psychic entities. It was a very different worldview from the one predominant today, and had much in common with the animistic philosophies of all traditional peoples. The religion of the Middle Ages was Christian animism - animism being the belief that nature is alive.

This animism was not only a sophisticated philosophy taught in the medieval universities but also was reinforced by popular practices, largely owing to a continuity of pre-Christian traditions that continued to

exist in Christian form, such as the a recognition of the Holy Mother, the honouring of holy wells & springs, pilgrimages to places of power, and the celebration of seasonal festivals linking the human community to the cycles of nature.

In northern Europe, much changed at the Protestant reformation when shrines, pilgrimages, the cult of the Holy Mother, and many of the great festivals were suppressed as relics of paganism, which indeed they were. In the Protestant countries these changes effectively desacralised the natural world. Religion then became almost exclusively preoccupied with the interplay of man and God, the drama of fall and redemption. The natural world was devoid of spiritual power, and was at best a neutral backdrop.

Desacralised nature could then be seen in a new way. There were no longer any religious restraints to the conquest and exploitation of Nature. Everything was up for grabs. It was Sir Francis Bacon who in the early 17th century most clearly put forward a new agenda for human domination through science and technology, emphasising the need for organized empirical research. Through probing Nature's secret places, as he put it, man could find out her secrets so that he could more effectively bind her into servitude and have dominion & power over her.

The feminists have had a good time with this kind of language, as you can imagine. Mother Nature no longer had any intrinsic value of her own, but was simply there for man to use as he saw fit. Bacon helped prepare the way for the mechanistic revolution in science, and this revolution first came to consciousness in a vision of René Descartes on November 10 1619. Descartes claimed that this vision was given to him by the Angel of Truth; in modern parlance we would say that it was channelled. It was a vision of a machine-like world, governed entirely by universal mathematical laws, with no inherent spontaneity or freedom. This was the essence of the mechanistic theory of Nature.

The soul, the animating principle, was withdrawn from the whole of Nature and from the the human body too. The world was deanimated and effectively became regarded as an automatic machine with no soul, no spontaneous life, and no purposes of its own. Animals & plants became inanimate machines, and so did the human body. The only part of the material world that was not entirely mechanical was a small region of the human brain, the pineal gland, where the rational conscious mind

of man somehow interacted with the machinery of the nerves. The old view was not that the soul is in the body, but that the body is in the soul. Now the soul survived only inside human heads.

This desacralised, deanimated, souless vision of Nature became the foundation for modern science, and was established as its reigning paradigm in the scientific revolution of the seventeenth Century. The new science involved an explicit rejection of the traditional idea that Nature was animate, and that all living beings had souls and purposes of their own. Mother Nature was now regarded as dead matter, subject only to mechanical forces, governed by mathematical laws.

I will now briefly go through the essential features of the mechanistic world-view, which is still the official philosophy that dominates science, medicine and agriculture, generally taken for granted in the media, in politics and in education, and underlies the ideology of economic development and technological progress. I will first spell out the main features of the mechanistic view of Nature, and then show how every single one of them has now been transcended or superseded by the advances of science itself, which is now leading us towards a post-mechanistic world view.

The philosopher of science Sir Karl Popper put it succinctly by saying that through modern physics materialism has transcended itself. This is a very important point, and one that is not widely realised. The image of science that most people have is at least fifty years out of date and often a hundred years out of date. There is no good reason, other than habit, why we should go on teaching an outmoded scientific ideology to children in schools.

New scientific ideas take much longer to filter through into general awareness than ideas in the arts or fashion or politics, taking decades rather than months. For example, the quantum revolution in physics occurred in 1927, but it wasn't until the late 1970s that it became a topic that could be discussed in polite society in England, following the publication of Fritjof Capra's *The Tao of Physics* in 1974. There is now a torrent of popular books about quantum theory, but there had been an awfully long time-lag. In the normal run of events the scientific changes I'm going to discuss will become part of popular consciousness somewhere around 2030. That may be too late.

The first feature of the mechanistic world-view is that it's based on the machine as its central image: the world as a machine; animals & plants as machines; human bodies as machines. The job of science is to find out their mechanisms. By contrast, all previous world-views took organisms as their principal source of metaphors and myths. Mechanists dismiss such organic metaphors as subjective or anthropocentric. But ironically, the machine is one of the most anthropocentric of metaphors, for only people make machines, and only recent people at that. It involves projecting modern man's fascination with machines onto the whole of nature.

This mechanistic universe is inanimate and purposeless. Inanimate literally means soulless. Purposeless means without any internal purposes. The whole course of nature is supposed to be pushed by causes from behind - rather than drawn by attractions or motivations from ahead, moving towards goals.

In the 17th century, matter became mere dead, unconscious stuff, made up of inert atoms. The Earth was thought of as a misty ball of rock hurtling around the Sun in accordance with Newton's laws of motion; it had no life of its own.
The whole course of Nature was thought to be determined. Everything went on inexorably, mechanically, and was in principle completely predictable. The whole of nature was thought to be essentially knowable to the mathematical reason of scientists.

The kind of knowledge that scientists had of the world was essentially disembodied. It was as if the scientist was not involved in what he was doing, as if he was seeing the world from outside. This was an essential part of the Copernican revolution in the 16th century. The idea that Earth was spinning, and was going round the sun, rather than the sun going round the Earth, involved seeing the Earth from outside, as it were. This is rather like the visionary journeying of shamans, travelling out of their bodies, and looking at the Earth from outside. The globe in every school classroom is a familiar reminder of this vision of the Earth from outside. It wasn't until astronauts got up into space that this view of the world from outside was turned into an actual experience; but meanwhile the imaginative disembodying has been very essential to the scientific revolution.

The idea that scientists are somehow disembodied, not bodily or emotionally involved in what they're doing, is part of the style of science to this

day. If you read a scientific paper you see “observations were made” and in school notebooks children learn to write in the this so-called objective style: “a test tube was taken. . .”. No-one actually does anything; things just happen in front of the observing, detached scientist. Of course, the reality of scientific research is very different, as anyone who has worked in a lab knows.

Then, in the 17th c., the whole of Nature was thought to be created by God, but to be in itself uncreative. Finally it was all governed by changeless laws that were thought of as eternal mathematical ideas in the mind of a mathematical God.

The God of the world machine was conceived of as a designing intelligence, engineer and mathematician - a clear case of picturing God in the image of man. This shift in world view to the mechanistic philosophy was adopted by many theologians. Newton and Descartes themselves were very interested in theology and laid the foundations of mechanistic theology. Protestant theologians in particular have tended to take it for granted that animals, plants and the world as a whole are machines, and have then tried to fit God into this mechanical picture as the great machine-maker.

Many scientists go into science because of some direct inspiration and then have it gradually suppressed by the mechanistic view of nature and by the need to treat living organisms in so-called detached, objective and unemotional ways. And of course the mechanistic theory provides a theoretical justification for vivisection in laboratories and factory farming in modern agribusiness. If animals are mere machines, they are neither conscious nor capable of feeling pain or emotions. If scientists are able to preserve that original sense of connection with the living world, they usually have to do it like everybody else in their free time, not in the laboratory or lecture theatre. John Morton is a wonderful exception.

The ‘great machine maker’ view of God has committed a whole tradition of theology - natural theology - to a mechanistic world-view. By regarding animals & plants as machines, their beautiful adaptations were taken as evidence of intelligent design by an external, machine-making God.

This is essentially what the scientific revolution of the 17th century put in place and it is still the basis of scientific ideology. The word

"mechanistic" in most circles is used as a pejorative, but in modern science, and especially in biology, it is a good word. The good guys are the mechanists; the bad guys are the 'vitalists' or the 'animists'. One has to remember that science has developed unevenly and the changes that I'm going to discuss have mainly happened in physics. Academic biology and medicine are still under the sway of the mechanistic world view, living fossils of an older mode of thought.

First of all, the idea of the cosmos as a machine has given way to the image of the cosmos as an organism. The Big Bang theory, which has been orthodox since around 1966, tells us the Universe began small and has been growing ever since. As it grows, a succession of new structures and forms appear within it. This is nothing like any machine we know of. But it is like the way an embryo develops or a tree grows from the seed. It implicity means that cosmology has adopted an image of a developing organism as opposed to a machine.

Mechanistic Universe	**Living Cosmos**
Machine	Developing organism
Inanimate	Fields
Purposeless	Attractors
Inert atoms	Structures of activity
Earth dead	Gaia
Determinate	Indeterminate, chaotic
Knowable	Dark matter
Disembodied knowledge	Participatory knowing
Uncreative	Creative evolution
Eternal laws	Habits

Cosmologies tend to mirror social preoccupations, and in the 1960s it was assumed the cosmos would grow indefinitely, in harmony with the idea that economies would grow indefinitely. We now have more doubts about unlimited economic growth, and in cosmology, sure enough, there is now something called dark matter looming in the background. No-one knows what it is, but if there is enough of it, it will cause the expansion to slow down, and eventually the universe will begin to contract until everything's annhilated in the opposite of the Big Bang, known as the Big Crunch.

The idea that Nature is inanimate has been replaced by the idea of Nature being organised by fields. Fields, like souls, are invisible organising principles. Magnets in the ancient Greek period, and right up until the 17th century, were thought to have souls. The soul was the invisible thing in & around the magnet responsible for its attractive and repulsive powers. Now we think of magnets having fields. Electromagnetic fields, from gamma rays through UV, visible, IR and the various types of radio, are similarly believed to propagate influences.

In area after area of science, the old idea of the soul as an invisible organising principle has been replaced by the concept of a field. So I would say that Nature is being reanimated through fields, which have taken on many of the traditional roles of souls in the pre-mechanistic paradigm.

Souls motivated organisms by attraction. The soul of the oak tree, according to Aristotle and to St Thomas Aquinas, drew the oak tree towards its mature form. The growing seedling was attracted towards the mature form of the oak. This kind of motivation by attraction was dismissed from science in the 17th century. It has recently been smuggled back in through the concept of attractors. These are central to the modern science of dynamics, and enable processes to be modelled in terms of where they're going to end up, rather than in terms of how they're being pushed from behind. I can't go into the technical details of this here, but it is significant that this concept has now become very influential within science.

The idea of inert atoms has given way to the idea of atoms as structures of activity. They do not consist of fixed, inert stuff, but rather of energy moving & oscillating within fields. So matter itself has turned out not to be fundamental; fields and energy are more fundamental.

The idea that the Earth is dead is giving way to the Gaia hypothesis. Gaia is the Greek name for Mother Earth. Effectively what modern science, following James Lovelock, is rediscovering, is the concept of the Earth as a living organism. This is news to some people in the west; but it's not news to most people throughout the world. I've tried talking to Indian villagers about this and they are profoundly unimpressed. When you tell them that modern science is now discovering that the Earth is a living organism called Mother Earth, you are telling them what they've known all along. And in a sense all of us have known this all along, but there's

now a way in which this old idea can be formulated scientifically. The Gaia hypothesis is a major step towards a recovery of the sense of living world.

The doctrine that everything is determinate, in principle totally predictable, suffered a blow with the development of quantum theory in the 1920s, when it was realized that there was indeterminism at the microscopic level. More recently the recognition of chaos and chaotic dynamics have made the old idea of determinism untenable not just in the quantum realm, but in the weather, in breaking waves, in the activity of the brain and indeed in most natural systems. Even the dynamics of the solar system, the classic exemplar of Newtonian mechanics, turns out to be chaotic in the long term. So chaos and indeterminism have given a greater sense of the freedom and spontaneity of Nature than anything that prevailed for more than three centuries while science was under the spell of the fantasy of total predictability.

The idea of the whole of Nature as totally knowable has also suffered a terrible blow with the discovery of dark matter. It now turns out that 90-99% of matter in the Universe is utterly unknown to us. It's as if physics has discovered the cosmic unconscious. Dark matter determines the structure and fate of the Universe, and yet we have few clues to what it is.

The idea of the disembodied knowledge of scientist is giving way to a sense of science as participatory. The observer is involved in what he or she observes. What is being looked for, and the way it is looked for, affects what is found. Moreover, the expectations of the experimenter affect what is observed, as in the placebo effect in medicine or the Experimenter Effect in psychology. We are coming to a more participatory sense of our knowledge of Nature.

The idea of Nature as uncreative has been superseded by the idea of creative evolution. Darwin helped us to recognize that Nature herself is giving rise to new forms of life in the biological realm, and in the light of the Big Bang theory we now see the entire cosmos as a creative evolutionary system. This of course raises in a new way the question of the nature of creativity. In an evolutionary world, creativity is an on-going feature of the developing cosmos.

And finally, eternal laws. These made sense in an eternal world but I don't think eternal laws of Nature make much sense in an evolving world.

Either one has to have an idea of evolving laws or, better, to get rid of this very anthropocentric metaphor. As C.S. Lewis once remarked, “To say that a stone falls to earth because it is obeying a law makes it a man and even a citizen”.

I prefer the idea of nature as governed by habits. This is the main thrust of my own scientific work. The habits are maintained by a process I call morphic resonance, the influence of like on like. For example, if rats learn a new trick in London, then rats everywhere should be able to learn the same thing quicker because the rats have learned it in London. The more that learn it, the easier should it become everywhere. Likewise, if a new chemical compound is crystallised in New York for the first time, the more this is done, the easier it should become for these crystals to form all around the world. If children learn to play a new video game in Japan, it should be easier for children to learn the same thing in other countries. These effects should happen even without any normal means of communication.

This hypothesis is of course controversial, and is still being tested. Most of the results so far point towards these effects being real. Nature may well have an inherent memory rather than being governed by eternal laws.

Taken together, these changes lead to a tremendous shift in world-view. But we’re not going back to the pre-mechanistic kind of animism. We are now in a post-mechanistic state, at a higher turn of the spiral, if you like. The new animism differs from the old animism in that living nature is now seen as developing and full of creativity. The pre-mechanistic view was of the Universe as a mature organism, or even as a senescent and decadent organism. We now see it as a organism still growing and developing.

This new view of living Nature brings the need for a new approach in theology. It makes a tremendous difference to the way that we think of the relations between God and nature, because we’ve all grown up with a idea that nature is mechanistic, inanimate, and soulless. Most people have never been completely won over to the mechanistic philosophy, but have tended to accept it from Mondays to Fridays. At weekends, a different view of Nature takes over as millions try to get back to Nature in a car. At weekends, on holiday and in their retirement fantasies, many people try to connect with Nature in a different way, forming an I/Thou

relationship rather than the I/It relationship that characterizes the mechanistic attitude. The idea of Nature as alive has been preserved by the romantic poets, and is in accordance with many people's direct, intuitive experience of the natural world. It is taken for granted by children. So it is by no means unfamiliar; it has simply been relegated to the realm of subjective experience and private life, while mechanistic attitudes have been endowed with the authority of scientific objectivity. But now science itself is leading us towards a new understanding of the life of Nature.

Modern science has opened up for us a vision of nature which is crying out to be reanimated, in which we can discover the possibility of intelligence and purpose at every level. What holds us back is not evidence, but merely a habit of thought and the preconceptions of materialism. Through a new dialogue between the realms of science and spirituality, I believe we can recover a far richer view of the natural world than either traditional religion or materialistic science can give us. We can once again see nature as a unity and God as the God of a living world. Our Christian faith, at present confined to relic populations of believers, could once again give new meaning and new vision to the world that science has revealed to us, as it did in a very different context in the Middle Ages. The alternative is for religion in general and Christianity in particular to be reduced to a mere lifestyle choice, a kind of personal hobby, while the serious business of understanding the universe is left to a materialistic science whose only conclusion can be that it is ultimately futile, meaningless and purposeless.

As this new dialogue takes place, I believe the basis of a new civilization will come into being, a civilization that will combine religion and science in a new and life-enriching way. John Morton is one of the people of our time who has kept alive and inspired a sense of these new possibilities.

The Discovery of the Beginning
The Surprising Convergence of Science and Scripture in our Time

Rob Yule

Festschrift from the symposium 'Science and Christianity'
to honour Harold Turner and John Morton, Auckland 01-4-21.

'The universe appears to be a device
contrived for the perpetual astonishment of astronomers.'
Arthur C. Clarke[1]

The Bible begins with a majestic opening: 'In the beginning, God created the heavens and the earth' (Genesis 1:1). This simple statement, unlike any other account of origins, says that the universe - everything that exists - had a beginning. Its very nature as a contingent reality testifies to the existence of a Creator.

Down the centuries there have been many attempts to deny this fundamental truth. Since the Greek philosopher Aristotle[2] in the fourth century BC, scholars and philosophers have put forward the view that the universe is infinite or eternal, to avoid the implication of a beginning. Till the 20th century this was viewed as a purely speculative question. But in one of the greatest intellectual dramas of human history, discoveries in 20th-c. astrophysics and cosmology have confirmed that the opening statement of the Bible is correct: the universe indeed had a beginning. The evidence for this conclusion has met with incredulity, resistance and outright denial, but in the end it has proved to be overwhelmingly conclusive[3].

Fudged Sums

Albert Einstein, *Time* magazine's 'Person of the Twentieth Century' and the best known scientist of modern times, was a German-born Jewish physicist who originally worked as an examiner at the Swiss Patent Office in Berne. For ten years he strove to incorporate gravitation into his theory. This he finally achieved in his General Theory of Relativity, published in 1915, which suggested that the universe is simultaneously expanding and decelerating, as though from some gigantic initial impulsion.

According to General Relativity, massive bodies alter the curvature of space by drawing nearby objects towards them. Einstein's conception of gravity suggested that all material bodies would coalesce unless the influence of gravitation were continually countered by the expansion of the universe itself. The original equations of General Relativity thus implied that all matter, energy, space and time must have expanded outwards from a single point of origin or 'singularity'. Both the matter-energy that makes up the universe and the space-time dimensions in which that matter-energy exists & operates come from a common origin, a beginning.

General Relativity pointed to an origin of the universe in the finite past. But so deeply ingrained was Einstein's respect for the prevailing belief in a 'static' universe and personal dislike of the theistic implications of a beginning point that he did a rather unscientific thing. He introduced a 'fudge factor' - the so-called 'Cosmological Constant' - to get his field equations to yield a static, non-expanding model, consistent with an infinite or unchanging universe[4]. Introducing this cosmic repulsion or 'antigravity' to cancel out the purely attractive force of gravity spoiled the elegant symmetry of his theory, but it enabled him to eliminate both expansion and deceleration - the inconvenient witnesses to the universe's beginning.

Receding Galaxies

Edwin Hubble was a pipe-smoking Anglophile American astronomer, who became something of a Hollywood celebrity in the 1930s for his discovery of the countless galaxies beyond our Milky Way. In 1929, viewing these galaxies through the powerful 100-inch Hooker Telescope at the Mount Wilson Observatory near Pasadena in California - then the largest telescope in the world - he observed a phenomenon

known as ‘redshifts’. The light from certain stars & galaxies appeared redder or longer in wavelength than should be, indicating - like the Doppler effect of a car engine dropping in pitch as it goes into the distance - that they were moving away from the observer. The clear implication of this discovery was that the universe is expanding outwards - the distance between galaxies continually increasing, like points on the surface of an inflating balloon.

Hubble’s discovery of galaxy redshifts was the first scientific evidence that the universe is not static but expanding. Stephen Hawking rightly calls it ‘one of the great intellectual revolutions of the twentieth century’ yet wonders why no-one had thought of it before, given that Newton should have realised that a static universe would soon start to contract under the influence of gravity[5]. The expansion clearly suggested that the universe must originally have come from a finite point of origin, and therefore cannot be eternal but had a beginning. From observations of this expansion came the famous ‘Hubble Constant’, enabling scientists to calculate the age of the universe from the velocity of its recession. Hubble’s calculations proved a finite age for the universe but had a large margin of error; current research has narrowed this to 15.3 (plus or minus 1.6) billion years, but it is still being investigated and vigorously debated[6].

Fallible Genius

Only in 1931, after the publication of Hubble’s law of redshifts and observation of the universe’s expansion, did Einstein discard the Cosmological Constant, reluctantly accept ‘the necessity for a beginning’, and acknowledge to George Gamow that by not trusting his original equations of relativity he had made what he called ‘the biggest blunder of my life’[7]. It is astonishing to think that a scholar of Einstein’s brilliance could have predicted this result had he trusted his original theorems of General Relativity but instead fudged his sums and missed a moment of opportunity. Einstein’s name is a synonym for intellectual genius. It could just as well be a symbol of human fallibility.

Einstein visited the Mount Wilson Observatory, to acknowledge Edwin Hubble’s discovery. In the course of a subsequent visit to Mount Wilson Einstein heard the Belgian priest-scientist Abbé Georges Lemaître expound his theory that the universe had been created by the explosion of a ‘primeval atom’ containing all the matter of the universe and was still

expanding. Jumping to his feet he exclaimed: 'This is the most beautiful and satisfactory explanation of creation to which I have ever listened'[8].

But Einstein appears never to have accepted the reality of a personal God. Like the 17th-c. Dutch Jewish philosopher Spinoza, he continued to believe in an immanent but impersonal God whose being is identical with the laws of nature. "I believe in Spinoza's God who reveals himself in the orderly harmony of what exists", he said, "not in a God who concerns himself with the fates and actions of human beings"[9] At most he accepted "the presence of a superior reasoning power"[10] believing that behind the intelligibility of the universe there was "something subtle, intangible and inexplicable", a "force beyond anything that we can comprehend".[11] In his celebrated 1930 article on 'Religion and Science' he spoke of the "cosmic religious feeling" one experiences before "the sublimity and marvellous order which reveals itself both in nature and in the world of thought".[12] But Einstein seems never to have fully embraced the implication of the beginning by acknowledging the existence of a transcendent personal God beyond nature, who brought the universe into being. To the end of his life he felt that a God who was sovereign and omnipotent would interfere with the integrity of natural laws and deprive human beings of responsibility for their actions[13].

Subtle is the Lord. In identifying God with the physical universe itself, it never seems to have occurred to Einstein that this is the very thing God cannot be if the universe is finite. He was a better physicist than theologian[14].

Searching for Loopholes

Hubble's experimental evidence that the universe was expanding provoked a flurry of attempts by theoretical physicists to produce alternative cosmological models that would fit the observational data but avoid the implication of a beginning. "Philosophically, the notion of a beginning to the present order of Nature is repugnant to me" the English physicist Sir Arthur Eddington wrote in the prestigious journal *Nature* in 1931; ". . . I should like to find a genuine loophole."[15]

Best known of the attempts to find a loophole was the 'Continuous Creation' or 'Steady-State' theory propounded in the mid-20th c. by British astrophysicists Herman Bondi, Thomas Gold, & Fred Hoyle[16]. They admitted that the universe was expanding, but clung to the notion

that it was infinite and eternal. Hoyle - who coined the name 'Big Bang' as a term of derision for the hypothesis he was rejecting - argued that matter was continuously coming into existence as the universe expanded, at the rate of one hydrogen atom per cubic mile of space per year. This theoretically allowed the universe to expand infinitely yet exist forever.

The Steady State model was formulated for explicitly philosophical reasons: because, as Hoyle explained, "it seems against the spirit of scientific enquiry to regard observable effects as arising from 'causes unknown to science'."[17] Ironically, this counts more against the theory than in its favour, for Steady State cosmology bears little relationship to the observable universe. Hugh Ross lists nine scientific observations that tend to refute it, including the lack of any mechanism to account for the observed expansion of the universe, the existence of the universal microwave background radiation, the enormous entropy of the universe, the observed abundances of the light nuclides deuterium and helium, and the difference in character between nearby and distant galaxies, indicating that the universe must have been different in the past from what it is now[18]. After promoting Steady State cosmology and maintaining that the universe is 'everything that there is' for three decades, Hoyle now admits the lack of supporting evidence, and acknowledges that the fine tuning of the universe makes it look as if "a superintellect has monkeyed with physics, as well as with chemistry and biology"[19].

As the Steady State theory began to look unsteady, some physicists in the 1970s attempted to salvage the infinity of the universe by drawing on Eastern religious ideas then popular in the 'counter-culture'. John Gribbin put forward the theory of an 'Oscillating' or 'Bouncing' universe, akin to the Hindu notion of cycles of reincarnation, in which 'the universe expands from a singularity, collapses back again, and repeats the cycle indefinitely'[20]. According to Princeton physicist Robert Dicke, an infinite number of these cycles of expansion and contraction would 'relieve us of the necessity of understanding the origin of matter at any finite time in the past.'[21]

Unfortunately for its devotees, this fashionable New Age theory is discounted by several lines of evidence. From our knowledge of entropy we know that the energy available to power these oscillations would decrease with each successive cycle, just as with a bouncing ball, implying that the universe would have reached inertial equilibrium long ago if it had existed for an infinite time[22]. Further, even assuming that the universe

contained enough mass to reverse its expansion, its mechanical efficiency is so low that further oscillation is impossible. 'In terms of mechanical energy' says Hugh Ross, 'the universe more closely resembles a wet lump of clay than a pumped-up volleyball.'[23] If it collapsed it would not bounce but go splat. But the *coup de grâce* to the Oscillation Theory is the recent discovery that the observed density of matter in the universe falls just short of what is required for gravity to reverse its present expansion and bring about its collapse[24].

Serendipitous Static

In 1965, two Bell Telephone Labs scientists, Arno Penzias and Robert Wilson, were measuring radio emissions from our galaxy, using a redundant radio receiving facility in New Jersey, originally built to track *Echo 1* the world's first experimental communications satellite. They found an annoying background noise which they could not eliminate, whatever direction they pointed their unusual trumpet-shaped radio antenna. They tried everything they could think of to remove the static, even cleaning pigeon droppings - delicately described by Penzias as 'a white dielectric material' - from their antenna. It took them some time to realise that they had accidentally discovered the residual energy of the 'Big Bang', the background radiation remaining from the original immense 'explosion' of radiant energy which marked the beginning of the universe.

Penzias & Wilson were jointly awarded the Nobel Prize for Physics in 1978. The time lag shows how long it took the scientific community to come to terms with their serendipitous discovery - even though the existence of background radiation had been predicted in 1946 by Russian-born American physicist George Gamow, as a consequence of his modification of Lemaître's hypothesis of the universe's origin in an exploding 'primeval atom'. What Penzias & Wilson found confirmed the origin and expansion of the universe first observed by Hubble in 1929. Their measurements showed that the microwave background radiation has a very low temperature, indicating that the universe had cooled from the initial searing fireball of radiation in the Big Bang to a current temperature of less than 3° above absolute zero. Subsequent researchers found that the temperature of this radiation was very uniform, or isotropic, no matter which direction they looked in the sky, indicating that the early universe was extremely uniform in composition.

The Almighty Bang is now only a residual whimper. But we can still hear it. Its sound has gone out through all the earth. I'm told it causes about 1% of the static on our television sets.

Wrinkles in Time

In November 1989, just as the Berlin Wall was coming down, NASA launched the Cosmic Background Explorer (COBE) satellite, a project 16 years in planning. Between January 1990 and April 1992 teams of scientists used its radiometers to measure more precisely the characteristics of this universal microwave radiation, now known as Cosmic Microwave Background (CMB). CMB is our most important evidence for conditions when the universe originated. Sometimes called 'the very first light'[25], CMB was first emitted about 300,000 years after the Big Bang, when electrons and protons in the primordial plasma - the hot dense fireball of radiant energy that comprised the early universe - cooled sufficiently to combine to form hydrogen atoms, releasing photons and allowing light to shine for the first time. Its origin is a further confirmation of the remarkable cosmogony of Genesis 1:1-5, where light is described as emerging from the dense, dark chaotic mass that comprised the primeval universe at its beginning.

Because universal microwave background radiation provides a snapshot of the early universe when matter first separated from radiation, it serves as 'the Rosetta stone of cosmology'[26], enabling astrophysicists to decipher the structure of the early universe. In April 1992 COBE's scientists published a stunning temperature map of the entire sky, based on the project's survey of the cosmic background radiation. The COBE measurements not only confirmed that the background radiation was extremely uniform, with an average temperature of 2.276° above absolute zero (i.e. about —270°C), but also showed that it contained minuscule temperature variations or anisotropies.

These minute ripples - at most one part in 10,000 - are the oldest structures in the universe. They indicate where the large-scale features of the universe - the galaxy clusters that exist today - would have first begun to form by gravitational attraction as the universe expanded. Without these tiny 'wrinkles in time', ripples in the radiation of the Big Bang, no galaxies and stars would have formed; our Milky Way galaxy, Solar System, home planet Earth, and we ourselves, would not exist today.

Poised in Existence

Further refinements in the measurement of these anisotropies were made by the Boomerang balloon-borne microwave telescope observations at an altitude of 38km over Antarctica. For ten days in December 1998 - January 1999 Boomerang's sensitive instruments conducted a 'cosmic ultrasound' of the early universe. The Boomerang results settled another long-standing debate, whether the universe will expand forever or collapse back on itself in a 'Big Crunch' or 'Big Bounce'. They revealed that the universe is, in astrophysical jargon, perfectly 'flat' or Euclidean in geometry. It is delicately poised just below its critical density and is capable of expanding forever, because there is not enough matter in the universe to make it re-collapse on itself[27]. As Russian Orthodox theologian Georges Florovsky had already foreseen on purely theological grounds, the universe 'has a *contingent beginning, but no end* '[28].

These discoveries abundantly confirm the Big Bang model of the universe's origin. "The big bang theory is no longer seriously questioned", says Professor emeritus James Peebles of Princeton University, doyen of modern cosmologists, summing up the discoveries of 20th-c. cosmology; "it fits together too well."[29] More details will undoubtedly be discovered. The universe will continue to astonish astronomers. In a few months NASA's long-awaited Microwave Anisotropy Probe (MAP) will measure the minute variations in the background radiation in a detail never possible before. That the universe had a beginning, however, has been demonstrated beyond reasonable doubt. Science has shown that the universe is not eternal or infinite, but originated in a gigantic explosion of radiant energy out of which emerged all matter, energy, space and time.

Infinite Implicate

The implications of these discoveries are astronomic. In a series of papers written between 1966 and 1970, English astrophysicists Stephen Hawking, George Ellis & Roger Penrose re-examined Einstein's theory of General Relativity and discovered that its operation guarantees a singular boundary not just for matter and energy but also for space and time[30]. They showed that as one extrapolates back in time the density of the universe and the curvature of space would approach an infinite value. An infinitely curved or shrunken space would comprise a 'singularity' lacking any volume. Space and time are inextricably linked in General Relativity; the absence of space would necessarily entail the absence of

time. But in the absence of space neither matter nor energy can exist either.

Thus, suggest Hawking & Penrose, General Relativity implies that the universe sprang into existence a finite time ago from literally nothing - at least, nothing physical. General Relativity implies an absolute beginning, before which neither time and space nor matter and energy existed. This beginning was absolute in the strictest sense, for space & time must have originated in the same initial event that created matter & energy.

Hawking says there was initially 'a lot of opposition' to his & Penrose's work, 'partly from the Russians because of their Marxist belief in scientific determinism, and partly from people who felt the whole idea of a singularity was repugnant and spoiled the beauty of Einstein's theory'. However, Hawking comments, 'one cannot really argue with a mathematical theorem', and as the experimental and theoretical evidence mounted, it became increasingly clear that the universe must have had a beginning in time, until (he says) this was 'finally proved' by the publication in 1970 of his & Penrose's paper, and the Big Bang singularity became the generally accepted description of the universe's origin[31].

Hawking's estimate of the finality of his proof was overstated, for in 1970 the operation of General Relativity had not yet been confirmed to a precision sufficient to satisfy the most sceptical scientists. But in 1993 the Nobel Prize for Physics was given to Russell Hulse & Joseph Taylor for their 20-year study of two massive neutron stars closely orbiting each other - the binary pulsar PSR 1913+16. With gravitational forces hundreds of thousands of times greater than in our solar system, this binary system enabled Taylor's team to test General Relativity to an accuracy of better than a trillionth of a percent precision, or to fourteen decimal places. These measurements occasioned Penrose's judgment that Einstein's General Relativity is 'the most accurately tested theory known to science.'[32]

The philosophical ramifications are profound. As Stephen Meyer says, 'Taken jointly, general relativity and the big bang theory provide a scientific description of what Christian theologians have long described in doctrinal terms as *creatio ex nihilo* - creation out of nothing. These theories place a heavy demand on any proposed causal explanation of the

universe since the cause of the universe must transcend time, space, matter and energy.'[33] This surprisingly obvious conclusion of the space-time theorem of General Relativity, says Hugh Ross, is 'a powerful argument for the biblical doctrine of a transcendent Creator.'[34]

Church of the Big Bang

Many astronomers and physicists, faced with this evidence, have become believers in God. One is Alan Sandage, Edwin Hubble's successor, who for three decades has been patiently refining the measurements for the expansion of the universe; he says, 'God to me is a mystery but is the explanation for the miracle of existence, why there is something instead of nothing.'[35]

Others, while not expressing faith, describe their discoveries in theological terms, as do Alan Guth and Paul Steinhardt in their pioneering account of the inflationary universe: 'The inflationary model of the universe provides a possible mechanism by which the observed universe could have evolved from an infinitesimal region. It is then tempting to go one step further and speculate that the entire universe evolved from literally nothing.'[36] The joke these days in universities is that if you want to find an atheist to debate the existence of God, you have to go to the Social Sciences, because you won't find any in the Physics Department; they've all joined the First Church of the Big Bang!

Robert Jastrow, founder & director of NASA's Goddard Institute for Space Studies, though himself an agnostic, acknowledges that this is 'an exceedingly strange development' which clearly points to the truth of Genesis. Theologians, he says, 'have always accepted the word of the Bible: In the beginning God created heaven and earth.' But 'for the scientist who has lived by his faith in the power of reason, the story ends like a bad dream. He has scaled the mountains of ignorance; he is about to conquer the highest peak; as he pulls himself over the final rock, he is greeted by a band of theologians who have been sitting there for centuries.'[37]

The Problem of Genesis

This unforseen development has profound implications for all of human culture. As Jewish physicist Gerald Schroeder remarks, 'This shift in scientific opinion, after millennia of opposition, represents the most significant change science can ever make toward biblical philosophy. Evolution, dinosaurs, cavemen are all trivial controversies when compared to the concept of a beginning.'[38]

The importance of the issue is evidenced by the extremes to which otherwise rational people will go to circumvent the evidence for a beginning. The sticking point is clearly the theistic implication of a beginning. John Gribbin remarks, 'The biggest problem with the Big Bang theory of the origin of the universe is philosophical - perhaps even theological - what was there before the bang?'[39] John Maddox, until recently editor of *Nature*, dismisses the Big Bang as 'philosophically unacceptable' and 'thoroughly unsatisfactory', because it implies that 'there was an instant at which time literally began and, so, by extension, an instant before which there was no time', rendering the universe 'an effect whose cause cannot be identified or even discussed.'[40] As Steven Weinberg observes, the real reason why some cosmologists are philosophically attracted to an alternative such as the Oscillating or Steady State model is that 'it nicely avoids the problem of Genesis.'[41]

The 'problem of Genesis' is that a beginning points to a Beginner. Admitting this would mean acknowledging that science itself calls in question the secularist worldview and the naturalistic account of origins. The discovery of the beginning is the greatest turning-point in intellectual life and the history of ideas for two and a half millennia. It has profound implications not just for science but for our entire cultural enterprise - for education, the media, arts, philosophy, religion and human self-understanding. For if it is true that the universe had a beginning, then world-views that presuppose an infinite or eternal universe, or deny the existence of a Creator, are demonstrably false.

At a single stroke, like St. George slaying the multi-headed dragon, the discovery by modern science that the universe had a beginning falsifies both ancient pantheism and modern atheism, the main rivals to the Judaeo-Christian worldview. If the universe is not infinite or eternal, monistic or pantheistic religions and philosophies which affirm that it is - including Hinduism and its various New Age derivatives in the West - are shown to rest on a false premise. If the universe had a beginning, it is clearly implied that it has a transcendent Creator, which undercuts naturalism, dialectical materialism, secular humanism, existentialism, and other forms of atheism which deny the existence and activity of God and assert the autonomy and self-sufficiency of human beings. By testifying to a living, active and all-powerful God, the discovery of a beginning invalidates even those secularised forms of Christianity, from Ludwig Feuerbach to Lloyd Geering, which suggest that 'God' is nothing more than a human construct or projection of human consciousness[42].

Unexpected Plot-Twist

Contemporary physics presents us with convincing evidence of the living, active, supra-dimensional God of the Bible. Hugh Ross explains that the creation event, as the origin of the universe's matter, energy, and space-time dimensionality, is an effect that includes our time dimension. Whoever caused the universe, therefore, must possess at least one more time dimension than ours, or some supra-dimensionality that encompasses all the properties of time. While transcending our space-time dimension and being in no way confined by it, God is nevertheless able to interact with the space-time universe. Thus, Ross concludes, 'The space-time theorem of general relativity establishes not only the creator's extra dimension(s) or their equivalent, but also his capacity to operate in all the space dimensions the universe has ever possessed (or their equivalent).'[43]

That secular science should provide such evidence for the biblical Creator is a surprising development, a plot-twist more unexpected than an exciting detective thriller. We are witnessing a remarkable convergence of science and theology in our time. As solid-state physicist Nathan Aviezer says, 'hundreds of years of intense scientific effort by some of the finest minds that ever lived has finally produced a picture of the universe that is in striking agreement with the simple words that appear in the opening passages of the book of Genesis.'[44] The very nature of this rapprochement is biblical in its scope and irony, suggestive of the humour of God. Using even human wrath to praise him (Psalm 76:10), the Almighty is fetching glory from an unlikely source - from naturalistic science, the greatest project of human endeavour in modern times.

Secular science has come to this discovery through its own inner logic and development. Indeed, as we have seen, evidence for the beginning has even been advanced by desperate attempts to shore up naturalism as contrary indications accumulated. 'Ironically,' observes Hugh Ross, 'those who fought hardest against God as the explanation for the cosmos often were the ones whose work provided the most powerful new evidences for him.'[45] Focussing exclusively on the natural universe, repudiating supernatural revelation, often showing an anti-supernaturalist bias, and displaying at times an overconfidence in human ability, modern science has come to a point where it is arguably bearing better witness to the Creator than contemporary theology.

At a time when many Christians have turned their backs on science, when most theologians have given up on natural theology, and when popular

Christianity has emptied faith of reason and evidential support, it is surely a supreme irony, a truly master stroke, that God should pull creation from his left sleeve and use science to win himself applause.

—-

[1] In his history of global telecommunications, *How the World Was One: Beyond the Global Village* (London: Gollancz 1992) p.193.
[2] Aristotle *On the Heavens*, 2.1, *Physics*, 8.1.
[3] Two classic books describe this development: Steven Weinberg *The First Three Minutes: A Modern View of the Origin of the Universe* (London: Fontana 1983) and Stephen Hawking *A Brief History of Time, from the Big Bang to Black Holes* (London: Bantam 1988). Clearer still, and better documented, are two books by Christian astrophysicist Hugh Ross: *The Fingerprint of God* 2nd. edn (Orange, Calif: Promise Publishing 1991), a well-documented survey of the vast field of 20th-century astrophysics & cosmology, and *The Creator and the Cosmos* 2nd edn (Colorado Springs: NavPress 1995) pp.19-76, which updates the story to the discoveries of the Cosmic Background Explorer (COBE) satellite.
[4] Israeli physicist Max Jammer suggests that the Cosmological Constant reflects the influence on Einstein of Spinoza's concept of an immutable God pantheistically identified with the extension of space: *Einstein and Religion: Physics and Theology* Princeton University Press 1999 pp.63, 247.
[5] *A Brief History of Time*, p.42.
[6] Recent measurements by Cowen, Sandage, Tamman, Tanvir and others are summarised by Hugh Ross, 'Big Bang Model Refined by Fire' *in* William A. Dembski (ed) *Mere Creation: Science, Faith and Intelligent Design* (Downers Grove, Illinois: InterVarsity Press 1998) pp. 367-368.
[7] Gamow, *My Worldline* (New York: Viking 1970) p.44, quoted by Max Jammer *Einstein and Religion* p.62.
[8] Peter Michelmore, 'Albert Einstein' *Encyclopaedia Britannica*, 15th edn Vol. 6, p.513.
[9] to New York rabbi Herbert Goldstein, quoted by Jammer *Einstein and Religion* p.49.
[10] Lincoln Barnett *The Universe and Doctor Einstein* (New York: Sloan, 1948) p.106.
[11] to Count Kessler, quoted by Jammer *Einstein and Religion* pp.39-40.
[12] *New York Times Magazine* 9 November 1930, section 5 pp.1-4, quoted by Jammer *Einstein and Religion* p.52.
[13] Albert Einstein *Out of My Later Years* (New York: Philosophical Library 1950) p.27.
[14] On the complex matter of Einstein's attitudes to God, see especially Ronald W. Clark *Einstein, The Life and Times* (London: Hodder & Stoughton 1973) pp.

31-34, 400-401; Hugh Ross, *The Fingerprint of God* pp.58-59; and *The Creator and the Cosmos*, pp.52-55, and now the comprehensive study by Max Jammer, *Einstein and Religion*.

[15] 'The End of the World: from the Standpoint of Mathematical Physics,' *Nature 127* 450 (1931).

[16] Herman Bondi & Thomas Gold 'The Steady-State Theory of the Expanding Universe,' *Monthly Notices of the Royal Astronomical Society 108* 252-270 (1948); Fred Hoyle 'A New Model for the Expanding Universe' *Monthly Notices of the Royal Astronomical Society 108* 372-382 (1948).

[17] Hoyle, *ibid.* p.372.

[18] *The Fingerprint of God* pp.95-6. Cf. P. J. E. Peebles, 'Making Sense of Modern Cosmology' *Scientific American 284* 44-45 (Jan 2001).

[19] 'The Universe: Past and Present Reflection,' *Ann. Rev. Astron. & Astrophys. 20* 1 (1982).16. Russell Stannard, in his 1997-98 Gifford Lectures at Aberdeen, tells of a fascinating conversation with Hoyle, confirming that Hoyle's change from militant atheism came after his inspired discovery, alluded to in this autobiographical reflection, that carbon first formed in the stars by nuclear resonance (The God Experiment{[London: Faber & Faber 1999}, p.184).

[20] 'Oscillating Universe Bounces Back' *Nature 259* 15-16 (1976).

[21] 'Cosmic Black-Body Radiation' *Astrophys. J. Letters 142* 415 (1965).

[22] Alan H. Guth & Marc Sher 'The Impossibility of a Bouncing Universe' *Nature 302* 505-507 (1983).

[23] *The Creator and the Cosmos*, p. 66, citing Guth & Sher, *art. cit*., and Sidney A. Bludman, 'Thermodynamics and the End of a Closed Universe' *Nature 308* 319-322 (1984).

[24] P. De Bernadis *et al* 'A Flat Universe from High-Resolution Maps of the Cosmic Microwave Background Radiation' *Nature 404* 958-959 (2000). Cf. the earlier papers of Peter Coles & George Ellis 'The Case for an Open Universe' *Nature 370* 609-613 (1994), and P. J. E. Peebles 'The Mean Mass Density of the Universe' *Nature* 321 27-32 (1986).

[25] John Mather & John Boslough *The Very First Light: The True Inside Story of the Journey Back to the Dawn of the Universe* (London: Penguin 1998), which tells the story of the COBE project.

[26] Robert R. Caldwell & Marc Kamionkowski 'Echoes from the Big Bang' *Scientific American 284* 28 (Jan 2001).

[27] Wayne Hu 'Ringing in the New Cosmology' *Nature 404* 939-940(2000); P. De Bernadis *et al* 'A Flat Universe from High-Resolution Maps of the Cosmic Microwave Background Radiation' *Nature 404* 955-959 (2000).

[28] 'The Idea of Creation in Christian Philosophy' *Eastern Churches' Quarterly 8* 56 (1949); cf. 'Creation and Creaturehood' in *The Collected Works of Georges Florovsky* Vol. 3, *Creation and Redemption* (Belmont, Massachusetts: Nordland 1976) pp.44-45.

[29] 'Making Sense of Modern Cosmology' *Scientific American*, 284 (January 2001), p.44. The recent reintroduction of Einstein's Cosmological Constant by some cosmologists does not call in question the universe's expansion or imply a return to a static universe, for it is now being invoked to explain the surprising discovery that the universe's rate of expansion is accelerating.

[30] Stephen Hawking & George Ellis 'The Cosmic Black Body Radiation and the Existence of Singularities in our Universe' *Astrophys. J. 152* 25-36(1968); Stephen Hawking & Roger Penrose 'The Singularities of Gravitational Collapse and Cosmology' *Proc. Roy. Soc. A 314* 529-548 (1970).

[31] Hawking *A Brief History of Time* pp.54-55.

[32] J. H. Taylor *et al* 'Experimental Constraints on Strong-Field Relativistic Gravity' *Nature 355* 132-136 (1992); Penrose *Shadows of the Mind* (New York: Oxford University Press 1994) pp.229-231, esp. p.230.

[33] 'Modern Science and the Return of the "God Hypothesis" ' *in* Richard F. Carlson (ed) *Science and Christianity: Four Views* (Downers Grove, Illinois: InterVarsity Press 2000), p.145.

[34] *The Fingerprint of God* p.111.

[35] *New York Times* 12 March 1991 p. B9, quoted by Hugh Ross *The Creator and the Cosmos* p.124.

[36] 'The Inflationary Universe', *Scientific American*, 250 (May 1984), p.102.

[37] *God and the Astronomers* (New York: Norton,1978) pp.115-116.

[38] *The Science of God: The Convergence of Scientific and Biblical Wisdom* (New York: Free Press 1997) p.22.

[39] 'Oscillating Universe Bounces Back' *Nature 259* 15 (1976).

[40] 'Down with the Big Bang' *Nature 340* 425 (1989). A resolute opponent of Big Bang cosmology, Maddox stated in this article that the theory was 'unlikely to survive the decade ahead'. Six years later he was still asserting its demise, 'Big Bang Not Yet Dead but in Decline' *Nature 377* 99 1995). Entering a wise caution about this sort of dogmatism, Peter Coles & George Ellis say 'our uncompromising position is that, in the end, theory must give way to observation. The history of astronomy and cosmology is replete with examples of strongly held belief that turned out to be wrong.' ('The Case for an Open Universe' *Nature 370* 610 [1994]).

[41] *The First Three Minutes* p.148.

[42] Ludwig Feuerbach *The Essence of Christianity* (1841); Lloyd Geering *Tomorrow's God* (Wellington: Bridget Williams Books 1994).

[43] *Beyond the Cosmos: The Extra-Dimensionality of God. What Recent Discoveries in Astronomy and Physics Reveal about the Nature of God* (Colorado Springs: NavPress, 1996), pp.23, 31.

[44] *In the Beginning - Biblical Creation and Science* (Hoboken N.J: Ktav, 1990) p. 17, quoted by Max Jammer *Einstein and Religion* p.255.

[45] 'Astronomical Evidences for a Personal, Transcendent God', in J. P. Moreland

(ed) *The Creation Hypothesis: Scientific Evidence for an Intelligent Designer* (Downers Grove, Illinois: InterVarsity Press 1994) p.171. In addition to Hoyle, examples would be leaders in the search for extraterrestrial life Frank Drake, Carl Sagan, Iosef Shklovskii, Robert Rood & James Trefil, and secular exponents of the anthropic design principle John Barrow & Frank Tipler.

Dr Finlay began the final session by reading a poem *Creation* by Professor Sir Robert Boyd, rtd Professor of Physics, University of London and Director of the Mullard Space Science Laboratory

All speakers & chairmen were on stage for the final session, except Dr May who had succumbed to flu.

Finlay: We invite questions on any aspect of the day so far.

Q: In a sense you've stolen my question by that poem! All the speakers seemed to know what they meant when using the word 'God'; can you help me there - what do you mean?

Mann: The other speakers will correct me if I'm mistaken, but I think they meant much the same very traditional meaning as I did: the eternal Person (traditionally viewed as three in one to reflect what we learn from the scriptures) who created the universe but is not part of it (except that when he lived amongst us he was part of it).

Q: Can you say it without traditional theological language?

Mann: No; and I don't want to. [laughter]

Creegan: By God I would mean the God who is the subject of the story of God in the Old and New Testaments. I would prefer that definition.

Yule: In relation to the topic of today's symposium, the basic distinction made by orthodox theologians from the very early centuries was to contrast created being - which is contingent, which came into existence but *need* not have existed - with God as uncreated Being. I think this is a profound distinction which, while it doesn't exhaust all the reality of God, gives a definition in contrast to our contingency.

Mann: Let me mention here a good book: Eric Mascall 'He Who Is'.

Finlay: One other point: in the history of Israel, the Israelite people first learned to know God as Redeemer, the one who saved them from bondage in Egypt; and then they learned to know him as Creator. I think for New Testament Christians the same is true: we know God personally first as Redeemer and then as Creator.

Q: This question is for Dr Mann & Dr Broom. You both made a contrast between the purposefulness of life and the apparent lack of purpose in non-life. Now, that poem reflects the idea that God has imposed purpose on both the living and the non-living, right from the Big Bang. Surely that's a better way to look at it.

Broom: I think I more or less agree with you there; but if we look at the living realm it has a kind of autonomous self-directedness that we don't find in the realm of non-living materials. The brute properties of a piece of crystalline material have no aspiration, whereas if we look at the simplest organism we find it is a being that wants to become, wants to realise its full potential. There is that distinctive difference, within the entities of nature. But in terms of the totality of the universe, the 'tuning' of the physical constants that the cosmologists talk about, that does seem to me all beautifully thought out.

Mann: I agree with the broad gist of the book by Barrow & Tipler 'The Cosmological Anthropic Principle' – a book riddled with mistakes, but none of them material. The concept is that the whole 16,000 million year story from the Big Bang does appear to be eerily directed toward the creation of the biosphere and - not to be too hung up on false modesty - the human species which only just lately God has made a particular 'thing' of. Now the role of the non-living in all of that is, on the one hand, at least quantitatively different; you couldn't see the same purposefulness in the silica tetrahedra. But on the other hand, even the humblest atom has its part to play.

Jones: Do my colleagues see any difference *within* living things in terms of purpose? And are we talking here of a purpose which is coming from outside, or (certainly in human terms) a purpose which is human-generated?

Mann: I think it's pretty clear that some kinds of organisms - again it's not a time for false modesty - have got better brains than other types and do have a wider variety of behaviour and can do more different things. Keep reading Genesis 3 now & again; I don't understand much of what it's telling us, but it sure tells us that we have free will and that we can misuse it to challenge our Creator. Now, a bacterium (so far as I can see), and most types of organisms, can't do that. We are the peculiar ... well, not quite mixture of devil and angel, but we have hints of both in us, don't we, and our behaviour, crucially including free will, is different from most kinds of organisms if not all.

Q. I have a confession to make in this gathering: I have great difficulty in believing in a personal God. Also I think our assumption that our species is unique is tremendous conceit. So I don't know whether any of the answers are here this afternoon. I've been very interested, very impressed; but no-one has convinced me that the human species is unique. And if there is a God, where does Jesus Christ come into it? This man may have had great inspirations in his day, and for his time he was very advanced; but I think it's just ridiculous to think of Christ as the son of this marvellous God that you've all spoken about. Thank-you.

Broom: On the uniqueness - I suppose we have to go on the evidence available to us. Certainly science hasn't thrown up anything that would challenge human uniqueness.

Where does Christ fit into our concept of God? I must say C. S. Lewis is my favourite for making difficult theology relatively digestible. He points up the question that if we think of God as a being that is transcendent, beyond human understanding, in what way could God reveal himself to us mere fleshly mortals? What does he do? He steps out of eternity and into this world, as a human being, incarnated as one of us. It seems to me that is the ultimate act of communication by God - he reveals himself in flesh & blood as Christ, his son. So I see it as a wonderful gesture, a divine gift to us humans to see, touch & handle God in the form of Christ.

Yule: I have a Samoan son-in-law. All his Christmases would come at once if he could become Tiger Woods' caddy. He gave me a great story from a golfing magazine. There's a Japanese multimillionaire who owns quite a number of golf courses in the USA and in the UK. He owns the Turnhouse golf-course which I gather is in W. Scotland; during a business trip to Britain he turned up there unannounced but was denied entry because he couldn't produce a membership card. Instead of throwing his weight around, he went away and duly applied for membership like anyone else. When the word got out that the owner of the whole shebang had been insulted in this way, but had approached membership like everybody else, his kudos went up enormously.

Now I take that as an analogy of the relationship of God to us. The owner of the whole shebang didn't throw his weight around but entered this world on all fours with you & me - as an infant, as a baby.

Behind this story is a profundity of theology which you can look up for yourself in the opening 14 verses of John's gospel. The *logos* , the principle of rationality & unity behind the whole of the universe, who had created us with a capacity for that awareness - as the early theologians

called it, *logikos* , a capacity for rationality - became a human being like us. There is a profound relationship between a transcendent creator who is the origin of the rationality & unity of the whole creation and the one who entered it. This is put in a story way, to make it accessible.

Mann: Let me agree with our questioner. It has been evident after centuries of very clever people dealing with these issues that you cannot *prove* the existence of God; nor can you prove, in that logical compelling coercive sense, what Jesus Christ was. It is in the nature of faith to be a Christian; and all that Christians can do is commend the Christian faith to their fellows, as Samuel Marsden did to some New Zealanders with good effect. It is a matter of faith, not logical proof.

Rev. Patricia Bawden: I hope you won't mind my quoting the Bible just for a moment. Dr Nicola said the God we are studying is the God of the Old & New testaments. Another participant said God had left it a long time. When I studied theology I read that God gave man time to come to himself. A parable tells of the killing of the worker and *then* he had to send his own son. I want to read a short passage from John I.

"In the beginning was the Word, and the Word was with God, and the Word was God" - so God was in that Big Bang at the beginning - "He was in the beginning with God, and all things were made through him, and without him was not anything made that was made. In him was life, and the life was the light of men. And the light shines in the darkness, and the darkness has never overcome it. . . . The true light that enlightens every man was coming into the world; he was in the world, and the world was made through him, and yet the world knew him not. He came to his own home and his own people received him not. But to all who received him, who believed in his name, he gave power to become children of God who were born not of blood, nor of the will of the flesh, nor the will of man, but of God." Thank-you.

Q: I'd be grateful if the panel would say something on the concept of **miracle** - a word that hasn't been used much today, but in the debate between science and Christianity the whole concept of miracle is very important. Going back to the comments of John Stenhouse on our historian and on Geering, this question of miracle seems to me to be a very important issue. How do you understand this concept of miracle in relation to science, the evolutionary process, and religion?

Turner: I don't understand the concept of miracle. But there's a big argument about how we should use the term - I know that much. I think

there is still a place for it in the whole range of our understanding of this vast mysterious universe. Certainly some of it we can best describe by that term. It's not a term I rush into using; I think we should be very cautious about using it. That's no sort of an answer, but it is a personal response.

Yule: Let me give a quote from John Donne: "the ordinary things in Nature would be as wonderful as the extraordinary, and only the daily doing takes off the admiration."

Finlay: The physicist John Polkinghorne draws an analogy. On the one hand he discusses the familiar, such as Ohm's Law which describes the movement of a current through a metal (say); and then he discusses superconductivity, a relatively new phenomenon which may seem to break the law of Ohm. Is superconductivity miraculous? Does it do away with well-established laws? Of course not. It's just that as knowledge advances it comes to a rationality at a deeper level. My understanding of miracles, such as the Resurrection of Jesus Christ, is that there is a deeper rationality in our world. It is not a capricious world, it is not magic; but there is a deeper rationality than we can in our normal experience understand. One day we will understand that deeper rationality.

Broom: If we have a view of God as acting constantly into his creation, then the concept of miracle becomes much less of a problem. Colossians I says he upholds things, he is immanent in his creation. That opens up the possibility of God's acting in different ways within the material world. As Graeme rightly says, it's not capricious but does upset us at times, and yet is perfectly consistent with his being a God who upholds his creation. I don't really see a major problem. It is a mystery. In a deistic view, God winds things up and leaves them to go along according to natural law; then miracle does present an enormous problem. But if we take a theistic view, holding that God is constantly acting into his creation as the living Word, then it's much less difficult.

Q: To Prof Gareth Jones: in the course of your talk, you referred to the dangers of human cloning and the uncertain nature of the technology and said it's unethical in the present state. It seems to me, though, that technology to develop needs to evolve and to be a process of experimentation. At what point and how do you determine when it might be ethically permissible to embark on human cloning? Do you just restrict cloning to animals until you feel it might be far enough developed?

Jones: Of course it's a matter of judgement; and I think you've answered it yourself at the end. It's like introducing any new procedure, any new technique, or any new drug, into medicine. To carry out a new surgical operation when the chances of its succeeding are about 1% would be quite unethical. One really has to have what is considered to be a reasonable chance of success, whatever that might be, because then you're always thinking of the well-being of your patient. Cloning, so far, has all been animal experimentation; there would have to be a huge amount more animal experimentation. When then you find in what might be appropriate species that you're getting offspring with very few deformities, without too may attempts at getting successful pregnancies and living offspring, then you'd have got to the point of considering that it might be ethical to proceed on the human scale.

It's exactly the same as has happened with IVF etc. Admittedly, some ethicists were arguing in the late 1960s that to proceed with trying out human IVF would be profoundly unethical because you could never know whether your first attempt would produce a malformed offspring. A very well respected theologian made that point, which has an element of truth. But of course when it came to it, enough experimentation had been done in those areas to justify what ended up as the first attempts. Inevitably of course there was experimentation with human embryos before the first IVF with Louise Brown in the late 1970s. It's a matter of judgement, a matter of doing appropriate work before you'd even be prepared to look seriously at the human situation, and I'd hope that in any reasonable country there would be appropriate guidelines before it was going to take place. But of course we have such a mess at the moment, with no legislation in most countries including New Zealand which has absolutely nothing; that, I think, is going to be the problem. There will be moves toward human cloning probably a long time before they should be embarked upon.

Finlay: IVF is a relatively straightforward procedure compared to the normal occurrence. Cloning is quite radical. Because induction is such a bad guide in biology - no matter how many species you try in, the next species may be different - is it not true, regardless of pre-clinical work, that the first attempt at human cloning will always be experimental?
Jones: In a sense, yes; but of course it was exactly the same with IVF. Those were precisely the reasons that people like Paul Ramsey used against IVF. What a lot of people don't realise is that there was considerable experimentation with human embryos through the 1970s before the first successful delivery. I'm not sure that the science will be ultimately

much different. While IVF may be 'easy to do' now, you must realise it wasn't in the late 1960s and early 1970s. The UK guidelines are by far the best in the world. The UK authority publishes annual reports on every clinic that performs IVF; every single birth is recorded, and every single abnormality, as in Australia too. They produce a booklet for intending IVF parents, which reveals that the success rates vary hugely between clinics. Whether it is ethical to allow the least successful clinics is a very interesting point.

Dr Harold Coop: Could I ask a lateral question please? We've heard a lot of erudition today, and I'm sure everybody is very impressed with the work the speakers have put in to give us such a wonderful symposium; but they are I believe speaking largely to the converted in these seats. Has the panel given any attention to a wider audience? I've written many times in the *NZ Herald*, spoken on Sunday Supplement and Morning Comment; I once had a 13-page article in *Metro* magazine on the decline of N.Z. society, which was followed by 5 months of correspondence. I believe there is a tremendous interest among young people in these subjects; but they get so little leadership. Many of us were brought up in sensible churches with parents & pastors who ushered us into these domains so we understand there's a world of interest in the subject matter we've heard today. Could we have some opinion on what strategies might help get this type of material to the public at large, especially younger people?

Finlay: I want to ask John Stenhouse how the State, and certain popularisers of humanism, fit in with the media. I don't know whether you've researched the media, but I think they have their own effects on what in fact is promoted.

Stenhouse: As I mentioned in passing this morning, the little sociological research on world-views in contemporary N.Z. society suggests that you're more likely to find secular world-views (atheism, agnosticism, various others - I'm begging many questions, but you'll forgive me for that) amongst university-educated, relatively affluent, younger folk. They are particularly likely to be found in government bureaucracies, in politics, and in the media. In other words, in understanding the secularisation of the culture we have to understand that different sectors get secularised far more rapidly than others. Therefore in discussing secularisation we have to specify precisely who, where and what we're talking about. So I think it's probably true to say the media

are less sympathetic to the kind of Christian position that was better and more sympathetically represented 30 or even 20 years ago. I think probably the media are more hostile on the whole than they were. I may be stretching a point to call them public intellectuals, but I noticed on TV that those who appeared on The Ralston Rort showed a new willingness to pooh-pooh religious belief, and a more dismissive attitude toward religious believers. So it's probably harder than it was to get moderate, sensible Christianity 'out there'; but I think it's an absolutely crucial task.

Curiously, Tim Watkin - chatting with me at lunchtime - suggested that perhaps he would do a feature in the *Herald* based on Lloyd Geering's response to my paper this morning. This made me very nervous; it's a quiet life down in Dunedin. But I think it's worth thrashing those sorts of things out.

The other historical dimension is that mainstream New Zealanders have from the beginning not really wanted to talk about our deep differences, even our disagreements about moral issues. On the whole I think we prefer to talk about safe subjects like the weather or the rugby, and it's 'not really done' to talk openly & frankly about our 'world-view' differences. I think this is partly a reflection of our Anglican & Presbyterian backgrounds. I think New Zealanders are increasingly reluctant to discuss these differences. But it comes at a cost; I think it impoverishes our public culture.

I think occasions like this are very good, but it certainly shouldn't stop there. I agree that we shouldn't simply preach to the converted; we should try to talk outside our own interest groups. Deuced if I know how.

Yule: We have here someone who's been making a contribution in the project to get astronomy into schools - John Dunlop [director, Auckland observatory - ed.]. This is a specific example of an exciting development, but a struggle.

John Dunlop: I've had a bit of fun with the media over the past few years. But my challenge to you folks on the platform is to do some provocative things that the media can't ignore. Whether you're a theologian or church leader or environmentalist, you can say some things that really stir up the secularists. I dared to criticise Americans for being arrogant in the space programme; and I got a lot of people saying 'good on you'. (Apologies to any Americans present.) We Christians are too nice. Jesus wasn't very nice, on occasion - at least the Pharisees and the sellers in the temple didn't think him very nice. I would challenge you to be more provocative and less smooth.

I have a question: can someone convince me that the benefits of cloning outweigh the risks & costs?

Jones: Oh, probably not!
Dunlop: Let's not do it, then.

Jones: But the question is, how are you going to stop people doing it, and for what reason? You could very seriously question in terms of cost/benefit analysis huge sectors of what we do in medicine, even though many of us stand to benefit from them; but does that mean we then attempt to ban it? If there are no benefits, then don't do it; but the pressures are there and it's going to happen.

Dunlop: That's fatalism. As an ardent young environmentalist in the 1960s and 1970s, I thought the world was going to end by 1990-odd; but it hasn't come to pass. People have moved away from nuclear threats and chemical pollution and become an awful lot more aware. Can we not do the same in medical ethics, worldwide? Aren't people rejecting genetically-modified foods, and bringing the big companies to heel by not buying their products?

Jones: When I say "it's going to happen" one should realise that the serious scientists are not interested in human reproductive cloning but in early cell development. I think the best book for a really good background is 'The Second Creation' by Wilmut, Campbell & Tudge. This will give you a very good feel for why the Wilmut group and many others have gone in a direction that has nothing whatsoever to do with human cloning. They are instead on the fascinating scientific drive to understand more about cell differentiation and to control the early stages of development. Some of the science is exceptionally good. It is intended to lead to improved pharmaceuticals. Whether that is essential is a different question.

As far as I'm concerned, human cloning is a bit of a nonsense. But it will come in because of infertility, not of "I want a replica of wonderful me" which is complete nonsense. One might say it shouldn't come. But there are no regulations in the USA when privately funded. I'm not sure how to stop it.

The serious therapeutic cloning is a completely different matter, with much more difficult ethical issues. Potentially we will all benefit from this.

Those of you who qualified in medicine 20 - 30 or more years ago

probably had no ethics teaching in your curriculum, whereas today there's very serious ethics discussion throughout medical curricula. At the University of Otago, one element of the 'teaching & learning plan' is that there should be social & ethical discussion in all areas across the university. Many papers in my department include very natural discussion of social & ethical consequences of what we're studying. When I teach neurobiology I raise ethical issues all the time. The students lap it up because it is relating where we're going . . . Alzheimer's disease, and dementia generally, is studied from the viewpoint of the neurobiologist, but then I will bring in some of the ethical issues in treating people with dementia. These sorts of things probably wouldn't have been welcomed even 10 years ago. That is admittedly not your general public, I know - but there is openness to values that there wouldn't have been a few years ago.

Stenhouse: Can I go back to John Dunlop's first point - that Christians are being too quiet and the secularists are taking over by default as it were? There are dangers. I certainly think we ought to take our place in the public sphere, and ought not to be cowed by the clamorous voices of Christianity's culture despisers; but I do think it matters how we take our place in the public square. There's a temptation to think we're an embattled tiny minority in a hellish secular culture going rapidly to the dogs. Calm down! We're not nearly as secular as Jim Veitch would suggest we are. I think there is a great deal of quiet, fuzzy culture-Christianity - more sympathy out there for the sorts of things we have to say. I'd like to illustrate with two stories.

I've been intrigued - some would say obsessed - with Lloyd Geering for some years now. One lesson I learned from Murray Rae, who was Maclaurin Chaplain here, is that when Lloyd Geering was tried for heresy in the late 1960s, many moderates and liberals in the Presbyterian church who didn't necessarily accept his theological position on the Resurrection were so alienated by the angry, rather nasty way his critics went about arraigning him that in reaction they kept silent or even supported his right to say what he said.

We're inclined to think we're a terribly secular sociey, but we should notice the quiet ways in which Christianity continues to bubble up in the public sphere. Whatever you think of Mrs Shipley's politics, consider what happened when a few years ago she made headlines by calling for religious education in schools. A few days later I asked my students in my religious history course and they told us the Bible In Schools movement is dead. Now Mrs Shipley wasn't calling for any kind

of proselytising; she thought all children should be taught about 'world religions' and should be introduced to their beliefs & values because, she said, society is too secular and that's having all sorts of social consequences. I think that's interesting, and I think she probably got a fair bit of support from what we might call middle New Zealand.

I have a fiercely secular colleague who however thinks the world of [Sir] Michael Hardie Boys, the [immediate past] Governor-General, a devout Anglican who got into controversy a few years ago when the then Minister of Youth Affairs, Deborah Morris, suggested condoms should be made available in schools. The Governor-General said yes, safe sex is an important message, but it's important to put sex education in schools into the context of a loving, committed, monogamous marriage relationship. He ended up quoting the Archbishop of Canterbury, but he did so respectfully, winsomely; I think his approach offers very important lessons for us.

So it does, I think, depend how we do it; but certainly we ought to do it!

Finlay: We ought to wind up. Are there any comments from the panel?

Broom: Regarding Harold Coop's comments about the younger generation not getting exposed to issues of science and Christianity, I think we can take a lesson from Richard Dawkins [laughter]. If you sell a million books, you can easily then fill the lecture theatre at the Royal Institution in London to overflowing, and sell your message there. Because he is promoting a message which is essentially atheistic, he gets very good support from the media. Now the challenge for us is somehow to get friends in high places that can open some of these doors. Listening to Robert today, while I wouldn't say things quite the way he says all things {**Mann**: no, of course not - couldn't have that!} there is a lot of fun and interest for the young in this whole area of science/God issues, so we need keys to open arenas. Some of us have struggled to get material into the papers, and it's extremely hard work; Harold Coop mentioned to me today that most of the time you're turned down. This is a very heavy scene here today; we have to think in more popular terms. We need to break down the ideas into biteable portions for the younger generation. There is a lot of work to be done.

Mann: The Festschrift that is to result from this gathering would be worth commending to your local librarian, wouldn't it? Take your copy, show it to your local librarian saying "buy that from the University of

Auckland". It's only a little suggestion, but it is little actions that generally move things to improvement.

Lest anyone feel overwhelmed or despondent at the secular trends of these past few decades, may I just remind you that in 1919 the not-yet-demobilised corporal who came to worldwide attention within a fairly short time was send in as a plain-clothes agent - a government spy - to report on a half-dozen crazies in Munich that no-one except the Germans with their characteristic thoroughness would have bothered to spy on. And he actually turned out to like these half-dozen crazies, and the rest (as they say) is history. A small number of people can change the world - in that case diabolically; why can't a somewhat larger number of good people change the world on behalf of God? Is it such a ludicrous idea? I don't mean that I have an exact plan for you - and if I fancied I had one, I wouldn't say it anyhow, as I dislike that kind of attempted coercion. But I do think small numbers of good people have often changed the world for the better, and I see no reason at all why it can't happen again. We're a lot more than that half-dozen crazies - Hitler, Goering *et al.* - we can do better than they did, can't we?

Finlay: Thank you for the questions; and I'm sure many others will continue to present themselves as we think about today's programme. Thank you very much, all the contributors, for all the stimulation we have received and all your hard work. Unfortunately the professor who was to close our day is ill, so I'll just have to do it.

I would again like to acknowledge our gratitude to Professor Morton and Dr Turner for their clear-sighted integration of science and theology. And I ask you to join me in thanking the other contributors for their hard work.

[applause]

I have a small token for each contributor. We decided we would present to each a copy of 'The Roots of Science' since it will be a classic; but not to Dr Turner - for him, some music [presents a CD; applause].

Thank you for coming, Professor Morton, and God bless you.

[Professor Morton stands to prolonged applause].

* * *

Closing remarks

Michael Pender

The organisers of this symposium honoured me with an invitation to make some closing comments. As things unfolded I was indisposed on the day. I had the opportunity, though, to read drafts of some of the contributions beforehand to assist in preparing my comments. What follows is an edited version of what I had intended to present, without, of course, the additional points that would have come to mind in the course of actually hearing the various addresses and discussion.

The interdisciplinary area of Science and Religion has become, in the last few decades, a vast and exciting field. I like to think of our existence as being embedded in four 'worlds' - the physical world, the living world, the conscious world, and the spiritual world. (One way of dealing with the problem of dualism!) Some of the papers in the symposium cover general matters to do with science and others focussing on biological aspects. In fact, when I saw the list of papers I wondered if the title should have been restricted to biological science - the living world. I am sure I don't have to remind the readers of this volume that there is a very considerable literature dealing with the interaction between Christian belief and the insights gained from knowledge of the physical world. I would like to comment about insights from the physical sciences as that is where my interest in the interaction between science and Christianity developed.

As a secondary school student in the late 50s and a university student in the 60s, I followed the discussions about scientific knowledge and religious belief. I was acutely aware that religious thinking seemed to be very much on the back foot. In those days there were two competing cosmological theories - continuous creation and what came to be called the Big Bang. Subatomic physics had developed rapidly and in exciting ways in the first half of the twentieth century, and there was no suggestion that this would not continue. A great sense of optimism in the power of science had been unleashed. So these were not easy times in which to hold Christian beliefs, as it seemed that science, not Jesus Christ, was to be the salvation of humankind.

Well things did not quite work out that way and by the end of the 20th century scientism was under attack. So much so that the later decades of

the 20th century saw an unexpected rapproachement, in some quarters at least, between religious belief and scientific understanding. One could not claim, of course, that this is widespread but nevertheless it was quite undreamt of in my student days. It seems to have been triggered, among other things, by scientific evidence supporting the Big Bang, the idea that our universe is not just any universe, but to have evolved to this state required a quite special beginning, and an ongoing sense of mystery at the workings of the subatomic world. Some time ago Neil Broom pointed out to me a statement in the closing pages of *The Cosmic Blueprint* (1980) by the theoretical physicist Paul Davies:

> "A review of the current thinking about the origin of life problem reveals a highly unsatisfactory state of affairs. The very fact that the universe is creative, in other words has organised its own self-awareness, is for me powerful evidence that there is something going on behind it all."

I find this an interesting view expressed by someone who was clearly not a believer in the Judeo-Christian God. Certainly not a view I heard or expected when, as a student, I first became aware of the science/religion debate. I offer this as evidence of a considerable development in the discussion between scientists and believers in the later decades of the 20th century.

The Vatican, through the Vatican Observatory, organised in the '90s major meetings on Physics, Philosophy, and Theology, and Quantum Cosmology and the Laws of Nature. These are based on the assumption of One World (to use the title of one of John Polkinghorne's early books) that the scientist and the believer are looking at different aspects of one reality. Another quote from Paul Davies, this time from the Vatican conference in 1996, indicating that his view has remained firm:

> "our ability to understand nature through the application of the scientific method is so surprising that it demands an explanation - points to a deeper level of explanation than just accepting the laws as a brute fact."

Harold explains nicely, towards the end of *The Roots of Science*, how it is that believers and scientists now find themselves allied in the realisation that they are dealing with different aspects of one reality - a reality that is independent of human beings but open to our investigation - certainly something real as opposed to the ideas of a postmodern world and beyond.

It has long seemed to me that the grandeur of the universe uncovered by

scientific discovery demands a more focussed response from the Christian community by way of reflecting on some of the grand ideas about creation expressed not only in Genesis but also in the NT. I have in mind the beginning of John's gospel and the ideas expressed by Paul in Romans, Philippians, Ephesians and Colossians - what has been called by Matthew Fox and others the Cosmic Christ. I have been surprised not to see this theme more developed; consequently I am pleased to see Murray Rae using some of these ideas in his paper when developing thoughts on stewardship.

The net effect of these developments in the science/religion interaction is that I have, in the last decade or so, moved away from the worries I had in my younger days about the credibility of the believer, and devoted more of my time to looking for the 'something going on behind it all'. I have attempted to move beyond contemplating the physical world towards seeking a growing awareness of the spiritual world. I am glad to realise that I am not alone in this and delighted with the few words that John had in the *Listener* of April 14 2001. What I responded to there was his emphasis on heart knowledge as well as head knowledge - a distinction the importance of which I have long been aware. I thus found John's contribution to the *Listener* particularly significant and complementary to the papers in this volume.

What John makes clear in the *Listener* is that we believers are involved with knowledge at two levels - intellectual (head knowledge) and emotional (heart knowledge). I regard the intellectual endeavour, such as is discussed in this volume, as a very important part of informing our belief and establishing our credibility, but, as explained above, I have for several years now paid more attention to developing heart knowledge. Although we Christians are strongly committed to the spiritual reality in our lives we are not particularly successful at conveying to others - perhaps not surprisingly as it is a difficult area - what this means for day-to-day living.

Indeed, I think spiritual awareness has an important role not only in individual lives but also in contributing to our understanding of what it means to be human. What, for example, does Paul have in mind when he is reported in Acts (17:28) as saying: "For in him we live and move and have our being"? Or John's gospel (14:23) when Jesus is reported as saying "Those who love me will keep my word, and my Father will love them, and we will come to them and make our home with them"?

Perhaps we need to flesh out ideas like these and present to the world a 'high' view of the human person, to support our ethical stance in matters such as abortion, euthanasia and genetic engineering. This year Professor Steve Pinker from MIT will deliver the Robb Lectures at the University of Auckland. In his books Pinker writes about the workings of the human mind. He touches on the traditional idea of the soul and summarises the reasons that many now find this an unacceptable notion. Yet this idea is a very important component of the Christian understanding of the human being, expressing as it does the idea that the Spirit of Jesus is to be found deep within the human person. I see reflection on these scriptural passages leading to a strengthening of our conviction that the human being is so much more than several trillion cells which are merely the product of the blind workings of evolution. It is an important task for the Christian community and a potentially significant contribution to the ongoing discussion between Christianity and science.

Finally, I want to say how much I admire the achievements of Harold and John who have been acknowledged and honoured by this symposium. Let me take you back a few weeks to Ash Wednesday and the joint service that my Roman Catholic parish had with the neighbouring Anglican community. The Anglican vicar was the speaker and he started off with a nice ecumenical gesture in talking about Pope John XXIII. He recounted how the Pope, soon after he was elected, said that he was an old man (late 70s) and his pontificate could only be a transitional arrangement. And yet in the five years that he was Pope he initiated changes in Catholicism such as had not been seen for several hundred years. The vicar then pointed out that it is never too late and one should not think of age as a bar to new endeavours! Could I say that this story reminds me of you, Harold and John, who have continued to be very active long beyond the age that most would regard as marking retirement.

Perhaps all of those participating in the symposium and who read these proceedings - and particularly those, like myself, on the downhill side of 50 - should take this to heart. It could be that the special task God intends for our lives has yet to begin - so far we have merely been in training getting to the starting position as it were! Thus I recommend these two to you as a model, and say that we should not be thinking that our work is nearing an end but remain alert, ready to be lead by the Spirit, to whatever grand task may come your way!

Finally my thanks to the authors of the interesting papers assembled herein, and congratulations to Robert, Neil, Nicola and Graeme for organising such a splendid occasion.

SELECT BIBLIOGRAPHY RELEVANT TO THE SYMPOSIUM H. W. TURNER'S PUBLICATIONS

The place of theology in the university. In H.A.E. Sawyerr (ed.), *Theology in Independent Africa* Freetown: (University College of Sierra Leone) 1961, pp.10-17.

A survey of religious buildings. *West African Religion*, no.2, January 1964, pp.1-2.

The Christian version of the sacred place. *Reformed Liturgies* (Princeton, N.J.) *4* (1) (1967) pp.19-40.

The Christian version of the sacred place and its New Testament norm. In F.L. Cross (ed.), *Studia Evangelica* V, Part II. Berlin: Akademie Verlag 1968, pp.141-45.

The phenomenology of religion. *Bulletin, Divinity Section* Association of Teachers in Colleges and Departments of Education (U.K.), *8*, Nov. 1969, pp.4-8.

Tribal religious movements - new. *Encyclopaedia Britannica* (1974 edn.), vol. 18, pp.697-705, together with 24 briefer articles on individual movements in the Micropaedia section.

From Temple to Meeting House. The Phenomenology and Theology of Places of Worship. The Hague: Mouton Publishers 1979, 404pp.

A model for the structure of religion in relation to the secular *Journal of Theology for Southern Africa* no.27, June 1979, pp.42-64, diagrams.

The history of Islam's mosques: a critical analysis. *Scottish Journal of Religious Studies 2* (2), 1981, pp.135-150.

My pilgrimage in mission. *International Bulletin of Missionary Research 13* (2), April 1989, pp.71-74.

Historical support for pluralism? The "Copernican Revolution" revisited, *Mission Studies* (Hamburg), no. 15 = *8* (1), 1991, pp.77-92.

Chalcedonian parameters for a Christian stance as prolegomena to dialogue, in D.B. Hamill and M. Rae (eds.) *Theological Fragments. Essays in Honour of Alan Torrance*. Dunedin: Lada Publications 1994, pp.19-25. [Methodological guidelines for all thinking, including religious studies and science.]Science and theology – a reply. *Stimulus 2* (2) May 1994, pp.46-47. [Reply to L. Perris's critique of comments on "constructivism" in *Stimulus 1* (4).]

Peirce and Polanyi. *New Slant*. no.6, Oct. 1994, pp.4-5. [Theists sharing the critique of Cartesianism.]

Religion: Impediment or saviour of science? *Science and Education* (Dordrecht) *5*, 1996 pp.155-64. [Commissioned critique of lead article on science and teaching religion in same issue.]

The Theological Significance of Michael Polanyi, *Stimulus 5* (1) Feb. 1997, pp.12-19. [Review article on Joan Crewdson, *Christian Doctrine in the Light of Polanyi's Theory of Personal Knowledge* 1994, preceded by exposition of Polanyi as philosopher of science.]

Macmurray and Polanyi, *Appraisal 1* (3) March 1997, pp.155-56. [Asking about any relationship between these two philosophers in Britain.]

Consequences of a basic mistake, *Stimulus 5* (2) May 1997, pp.37-42. [Rejection of Lloyd Geering's treatment of Christianity as a dualist faith by wrongly including Hebrew religion among the dualist Axial Age religions.]

Doing justice to Western culture, *New Slant* no.17, March 1998, p.6; repr. in *The Auburn Report 11* (2), April 1999, pp.10-11. [Defends its contribution of science to the world.]

The Roots of Science. An Investigative Journey Through the World's Religions. Auckland: The DeepSight Trust 1998, 204 pp.

Oldham, Temple and Polanyi, *Appraisal 2* (3) March 1999, pp.143-4, 148 (Discusses their relations)

Water, *Stimulus 8* (3), August 2000, pp.24-25.

Frames of Mind. A Public Philosophy for Religion and Cultures. Auckland: The DeepSight Trust 2001, 304 pp.

SELECT BIBLIOGRAPHY RELEVANT TO THE SYMPOSIUM JOHN MORTON'S PUBLICATIONS

His main publications on our theme are:

Man, Science and God (Auckland & London: Collins 1972);

Redeeming Creation (Auckland: Zealandia Press 1984);

Christ's Creation and the Environment (NZ Anglican Press 1989)

THE CONTRIBUTORS

Harold Turner founded in Dunedin two halls of residence, the University Book Shop and the student chaplaincy, then taught theology & religious studies in five countries overseas. Retired in his homeland he founded the DeepSight (originally Gospel & Cultures) Trust with vice-regal patronage, critiqueing our culture and publishing Christian scholarship. To his book 'The Roots of Science' he has recently added 'Frames of Mind: A Public Philosophy for Religion and Cultures', and the autobiography 'The Laughter of Providence'.

John Morton qualified M.Sc at Auckland, then Ph.D London, and became a leading marine biologist and expert on the molluscs, gaining the D.Sc degree young. As the first professor of zoology at Auckland he was instrumental in founding the Leigh Marine Laboratory. On the Auckland Regional Authority he promoted regional parks. In numerous conservation campaigns he has applied ecology to public policy. During long service on synods and other Anglican bodies John was instrumental in arranging the ordination of women. Retirement has allowed more writing on theology, and a new book on Pacific seashores.

John Stenhouse teaches history at the University of Otago. He has published mostly on 19th-century science and religion - most recently a collection edited with Ronald Numbers titled 'Disseminating Darwinism: The Role of Place, Race, Religion, and Gender' (NY: Cambridge U. P. 1999).

Stephen May is Lecturer in Systematic Theology at the College of St John the Evangelist, Auckland. He is particularly interested in the relationship between theology and other disciplines such as science and literature, on both of which he lectures. His book, 'Stardust and Ashes: Science Fiction in Christian Perspective', was published by SPCK in 1998.

Nicola Hoggard-Creegan is Lecturer in Theology at the Bible College of New Zealand. She teaches systematic theology and has research interests in the science/theology interface, feminist theology, and Schleiermacher.

Neil Broom teaches Materials Science in the Engineering School at the University of Auckland, is actively involved in bioengineering research, and wrote 'How Blind is The Watchmaker?' (Ashgate 1998; 2nd edn InterVarsity Press 2001).

Robert Mann was a Senior Lecturer in Biochemistry, and then the first (& last) Senior Lecturer in Environmental Studies, University of Auckland. Public policy on dangerous technologies has been his main interest. In retirement he pursues appropriate technology, and some aspects of theology.

Gareth Jones is Professor of Anatomy and Structural Biology at the University of Otago. He has written extensively at the interface of bioethics & Christianity, including 'Brave New People' (IVP 1984), 'Manufacturing Humans' (IVP 1987), 'Valuing People' (Paternoster 1999), and 'Speaking for the Dead: Cadavers in Biology and Medicine' (Ashgate 2000). He is a coauthor of the textbook 'Medical Ethics' (OUP).

Murray Rae, a Presbyterian minister, gained his Ph.D in theology at London, was then Maclaurin Chaplain in the University of Auckland for 3 years, and has now been called to his 'home' department of theology & religious studies, Kings College, London as Senior Lecturer in Systematic Theology. He has published a book and a number of articles on Søren Kierkegaard.

Rupert Sheldrake, a biochemist from Cambridge University, has been a research fellow of the Royal Society and researched tropical crops in India 1974-78. Back in his homeland, he has been building bridges between science and religion, notably in his book 'The Rebirth of Nature' (Century 1990) and in his dialogues with theologian Matthew Fox in their books 'Natural Grace' (1996) and 'The Physics of Angels' (1996) exploring how nature may be resacralised while avoiding pitfalls such as pantheism and animism.

Participants on the day
from L: R Mann, R Yule, J Morton, S May, N Hoggard-Creegan, G Jones, G Finlay, N Broom, J Stenhouse

On the morning of the symposium the following article appeared in the main Auckland newspaper, the *New Zealand Herald*. It is reproduced here, with the photograph that accompanied the article, by kind permission

http://www.nzherald.co.nz/
storydisplay.cfm?thesection=news&thesubsection=&storyID=183940

Let's thank God for the wonder that is science

Few debates generate more heat and less light than those that take place between science and religion.

TIM WATKIN talks to two men who think there is no argument.

The relationship between religion and science has often been presented as a choice, you might say, between two apples: Adam's or Newton's. It's either creation or evolution, faith or observation, design or chance.

But a symposium at Auckland University today, titled simply Science and Christianity, suggests another approach. It honours two of this country's leading Christian academics - theologian the Rev Dr Harold Turner and scientist Professor John Morton - who believe that both Adam and Isaac were holding the same apple.

In the university's Maclaurin chapel, the conversation between Dr Turner, aged 90, and Professor Morton, 77, tended towards hearing aids and falls their wives have had. Don't entertain any thoughts about doddery old men, however. Mentally, they run sub-four-minute miles.

The idea that science and religion are combatants, or even divided explorers - friendly but separate - doesn't wash with them.

"The universe isn't like that. It's one uni-verse," said Dr Turner. The sum total of human learning and insight did not, and could not, lead to either the realm of science or of religion.

"No, we end up in the realm of truth, which is a word that is hardly ever used now in our culture, and some people, when they do use it, put it in quotes. So-called 'truths.' Yet it's the only thing that matters," he said.

Professor Morton nodded. "I'd go along totally with that. It's the unity we're looking for ... science and religion blended produce one unity."

Such insistence that science and religion are meshed puts the pair at odds with thinkers such as Stephen Jay Gould. In his latest book, Rocks of Ages, Gould described science and religion as two pictures, side by side in a gallery, "different canvasses, each circumscribed by a sturdy frame.

"I do not see how science and religion could be unified, or even synthesised, under any common scheme of explanation or analysis; but I also do not understand why the two enterprises should experience any conflict," he wrote.

"Science tries to document the factual character of the natural world, and to develop theories that coordinate and explain these facts. Religion, on the other hand, operates in the equally important, but utterly different, realm of human purposes, meanings and values."

In other words they are two separate apples - one relying on reason and testable hypotheses, while the other, no matter how much you study and test it, ultimately requires a statement of faith.

Turner disagrees. "It's a cop-out," he said. "This disjunction between faith and reason is quite wrong.

"I'm saying that there's a whole lot of different rational processes. Faith is the appropriate process to deal rationally with the revelation of God. The appropriate rational process for dealing with rocks is quite different. You won't get anywhere with rocks if you start praying. And you won't get anywhere with God if you start knocking around with a hammer.

"Gould's division is just old-fashioned Greek dualism. I'm saying the universe is a unity, our minds are one mind, everything is interlocked with everything else."

The men's contribution to the tradition of Christian thought in New Zealand - indeed in the world, such is their status - will be outlined this

morning by John Stenhouse, a senior lecturer in history at the University of Otago.

"They have carried out their Christian scholarship confident ... that, in finding out about the workings of of the world and its creatures, they are obeying the great commandment to love God with mind and heart," said Dr Stenhouse.

Dr Turner has spent much of his career overseas, teaching and building theology courses in West Africa, Britain and the United States. Professor Morton, on the other hand, has had a career as a marine biologist and was the University of Auckland's first Professor of Zoology.

Dr Stenhouse said these were just two of New Zealand's many renowned thinkers who had been marginalised by a repressive state and a distinctively New Zealand desire not to rock the boat.

"Fairly early on, at least mainstream New Zealand decided we'd talk about the weather or the rugby as a way of helping us cope here and get along. But it's had the effect of blinding us to the reality of the diverse traditions that have always existed in this culture."

He told the *Herald* "Turner and Morton are the kinds of people who give the lie to the argument popularised by people like Lloyd Geering and Keith Sinclair that this society is secular and has always been."

Certainly Professor Morton has always looked outside the secular society of scientists, arguing that faith comes first and study follows. He quoted St Anselm: Credo ut intelligam - I believe in order that I may understand.

Dr Neil Broom, an engineer turned biologist, remembers Professor Morton's "10 beautifully presented lectures on evolution" that he attended as a student. Professor Morton then offered an optional lecture - not part of the formal course. "In this lecture he gave the class a glimpse of the vaster horizon that lay beyond the raw science of the preceding 10 lectures."

Those speakers at today's symposium all have a common concern - that science too often claims to be the exclusive and irrefutable path to truth and is bound by the commandment "thou shalt think only materialistically."

Turner said: "There has been a stream in our culture of belief in science as the ultimate and only true form of knowledge, which can tell us anything in the end if we just spend enough on research. But you would call that scientism - it's an ism - and a decent scientist wouldn't hold to that. He'd be too humble."

One such humble scientist is geneticist and author Colin Tudge. Writing in the *New Statesman* recently, he held that "science is not an edifice of truth, built stone by stone. It is a landscape painting, never finished ... We can be certain at any one time only that there is more to know."

Dr Broom argued for the value of both traditions, saying that while science had unearthed the building blocks of life and its laws, it told us little about how life was shaped and why it was in the shape it is.

To build a stately mansion, he said, no one would order a construction of silicate pyramids, even though they were the molecules that made up clay particles, which, in turn, formed the substance that was made into bricks. Evolutionary steps were required before silicate pyramids could become a mansion.

Science could tell us the material laws crucial to construction, but the question it failed to answer was how those silicate pyramids, by themselves, came to take the form of a stately mansion. Religion supplied an answer in the form of a divine architectural plan. "What is required is a conscious agent willing that plan to be realised."

Dr Broom said Darwinism actually pointed to the presence of that agent.

"Natural selection, far from being merely an immoral force, as inevitable and uncaring as gravity, is intensely purposeful and goal-centred and is strongly suggestive of a transcendent dimension."

Evolution has been the most public battlefield on which science and religion have fought ever since Darwin returned from the Galapagos Islands.

While the symposium deals with more underlying issues, Dr Robert Mann, formerly environmental studies senior lecturer at Auckland University, has tipped his hat to the argument, making the point that "to admit evolution as a fact is not to deny creation but only to say that it has been more or less continuous."

But the debate goes deeper, beyond questions of what happened to questions of why.

"The Big Bang and the subsequent workings of the laws of chemistry and physics - a dazzling set of efficient causes of the world we now live in - hardly begin to explain why organisms came into existence, or why they so marvellously cooperate in ecology," said Dr Mann.

The clear message is that science and religion are entirely compatible: they are teammates in a three-legged race rather than competitors in a marathon.

Indeed, Dr Turner, in contrast to those who argue that the Genesis story and science are poles apart, takes the radical stance that the Hebrew world-view laid the ground in which science took root. It's an extreme departure from the widely accepted view that science was a gift from the Greeks first and foremost.

But the Greeks, he said, held too many things sacred for science to flourish. "If there are spirits in animated things you can't approach them scientifically, put them on a lab bench and pour hydrochloric acid on them. They're sacred."

Conversely, Hebrew culture drew a distinction between the creator God and creation. While acknowledging the Greeks' laws and philosophies, Arabic numbers and the many other fertilisers that made the growth of science possible, Dr Turner said the Hebrew world-view, as spread through Judeo-Christian religion, was "the greatest cultural revolution in the whole of human history.

"With this new natural philosophy the world was cleared of gods and spirits, and declared to be the good creation of the one rational God; the foundations had been laid for the study of the universe that we know as science."

One truth that the careers of Professor Morton and Dr Turner, and many like them, has laid bare was summed up in Tudge's essay: "Non-scientists who fear that God's mystery has been forever compromised need have no fears; in the end, there is always mystery. "Those who suggest that it is blasphemous to probe God's intentions are themselves guilty of blasphemy. God is not a conjurer, whose tricks seem tawdry when exposed. The more you see, the more wondrous it all becomes."

* Science and Christianity symposium, 9 am to 5 pm, Maidment Theatre, Auckland University, today.

ISBN 0-86869-009-0