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Donald MacCrimmon MacKay (1922 – 1987): Scientist and Accidental Philosopher. A Critical Appreciation.[1]

In this paper I present an overview of the life and work of Donald MacCrimmon Mackay, a distinguished Christian polymath who made significant contributions across a number of domains in science and philosophy in the middle part of the 20th Century, and the centenary of whose birth was in 2022. After a brief biographical sketch, we will review his contribution to theology & science, the main ones of these being: complementarity, an innovative concept relating information and matter, and mind and brain; and logical indeterminism, a proposed solution to the problem of free will and determinism. I hope that this overview will stimulate interest in, and further exploration of, his ideas.

Keywords. Determinism, Free will, Compatibilism, Complementarity, Realism, Logical Indeterminism, Theology & Science

Donald MacCrimmon Mackay was a distinguished Christian polymath who made significant contributions across a number of domains in science and philosophy in the middle part of the 20th Century. He was a pioneer in the early days of information theory, artificial intelligence, and neuroscience; and as a leading figure in the early days of the Research Scientists Christian Fellowship (which later became Christians in Science) he made several important contributions to the subject of theology & science. Unfortunately, he is relatively unknown these days, but since the year 2022 marked the centenary of his birth, this seems like a good time to introduce a new generation to his life and work.

The fact that people do not know much *about* him would not have bothered MacKay: he did not reckon analysis of his personal life important, preferring that his ideas be scrutinised instead. "When reminded that he was a model for many in the UK and USA he would smile and shake his head."[2] As with any presentation of another person and their work, especially when they covered a wide swath, it is inevitable that the perspective and the interests of the author influence what is reported and what is omitted. In keeping with this I shall

1 Parts of this paper were first presented at the Christians in Science Autumn Conference 2022 –The Clockwork Image – Humanity, Artificial Intelligence and God; Celebrating 100th anniversary of Donald M MacKay

2 Haas, J. W. 'Donald MacCrimmon MacKay (1922 – 1987): A view from the other side of the Atlantic', *Perspectives on Science and Christian Faith* 44 (1992): 55–61.

only give a brief overview of his life and focus mainly in his ideas insofar as they are relevant to the aims of this journal.[3] Finally, a word about the title. Donald Mackay was first and foremost a scientist in his professional life, and so that comes first in the description of him. The term "accidental" is ambiguous and used in two senses to convey that, first, his philosophical and theological ideas arose from his consideration of scientific results, rather than directly from philosophical reflection; and also in the sense that philosophy was ancillary to his primary interest. Of course, there is nothing secondary about the substance of his philosophical-theological output.

A brief biography

In a paper of this kind and length it is not possible to provide a detailed biography, so this section may be seen as edited highlights. A more detailed account can be found in in David Norman's PhD thesis[4] and there are also a number of eulogies written from different perspectives around the time of his death.[5]

Early Years

Donald MacCrimmon MacKay was born in Lybster, Caithness, the eldest child (and only son) of Henry (a Free Church of Scotland minister and GP) and Janet MacKay. Much of his childhood was spent in Wick, where he attended the high school. Growing up in the Free Church Donald received a solid biblical and theological education, both in church and at home, which stood him in good stead in later years.[6]

During his teenage years Donald developed a keen interest in physics, particularly electronics and set up a laboratory in the garden shed. He and some other like-minded pupils formed a radio club that adopted the motto 'It is better to send than to receive'[7] (so the biblical education was paying

3 However, and notwithstanding his preference, there is a need for an analysis of his life and contributions from an history of science perspective. Though that is a task for someone with more expertise and interest in history.

4 Norman, D. 'Mind, Body, and the Philosophical Theology of Donald M. MacKay' (PhD diss., University of Edinburgh, 2004), ch. 2.

5 Evans, E. F. 'Donald MacCrimmon MacKay, 1922 – 1987', *Experimental Brain Research* 66 (1987): 225–227; Haas, 'Donald MacCrimmon MacKay (1922 – 1987): A view from the other side of the Atlantic'; Paul Helm, 'The contribution of Donald MacKay', *Evangel* 7, no. 4 (1989): 11–12.

6 Much of the information for this biographical sketch was gleaned from Valerie MacKay's unpublished biography of him: MacKay, V. 'Donald M. MacKay: A Biography by his wife, written for their grandchildren' (Unpublished, 2021).

7 MacKay, V.

off). This was a time when radio communication was becoming more readily available commercially, and his ability to keep the family radio operating properly and to repair friends' radios enabled him to demonstrate his entrepreneurial spirit. He set up his own little business and was in such demand that he was able to supplement the family finances. Such was his proficiency in practical electronics that a wartime colleague commented that 'Donald must have been born with a soldering iron in his hand.'[8] In the latter part of his school career Donald would sometimes head off on his bike into the countryside and read. One of the books he enjoyed was Arthur Eddington's *The Nature of the Physical World* which introduced him to the interaction between physics and philosophy (though he did not realise the significance at the time).[9]

He finished his time in secondary education as *Dux*[10] of Wick High School and went on to study Physics (with a specialisation in Electronics) at St Andrew's University in 1940. Because of the exigencies of war, the honours degree, normally four years, was squeezed into three. In later life he was happy to tell stories of his time at St Andrews that were against himself and showed his impish sense of humour. One such relates to a fellow student in Halls who tended to play his radio rather too loudly for Donald's liking. To counteract this he constructed a device that would interfere with the radio signal so that it became mostly noise. Then every time the radio got annoying Donald would switch on his device and listen instead to the expressions of puzzlement and frustration emanating from the other student's room. Eventually the radio playing stopped.

As part of the war effort there was a programme set up to find the best young scientific minds to work on top secret projects. Donald, with prizes for physics and maths and a first class honours degree, was identified as an ideal candidate and approached to work at the Admiralty Research Establishment (ARE) on what would come to be known as Radar.[11]

One unfortunate aspect of the religious climate in the early part of the twentieth century was a tendency to defend Christianity by 'clever arguments to show the limits of science.'[12] As a science student he found these underwhelming, which created a crisis of faith. While he did not stop at-

8 Evans, E. F. *op.cit*. 1987' E. F. 'Ted' Evans was a close friend and colleague of MacKay, and succeeded him as Head of the Department of Communication and Neuroscience at Keele

9 This is the book of his 1928 Gifford Lectures: Eddington, A. S. *The Nature of the Physical World*, 1st, Cambridge: CUP (1929).

10 *Dux* is name given to the school pupil who achieved the top academic performance in their senior year at school.

11 MacKay, V. *op.cit*.

12 Barclay, O.R.'The Open Mind and other Essays: A Scientist in God's World', chap. Forward, ed. Melvin Tinker, IV (1988).

tending church completely, religion took a back seat during most of his undergraduate career. This was also a time where Donald's view of science was such that he could not see what the point of philosophy was.[13] Fortunately in later life he changed his view on this, though his primary interests always remained scientific.

Young Researcher and Academic

Donald moved to the South of England to carry out the initial work that would inform the rest of his career. The development and construction of radar equipment involved a thorough understanding of the new disciplines of communication and information as well as control theory, and Donald quickly became an expert in these. But he was not a disengaged backroom boffin; he was fully involved with the development, deployment, and commissioning of the state-of-the-art equipment and spent time at sea monitoring its performance and effectiveness (even though he did not particularly enjoy the nautical experience).[14]

One of his fellow researchers at ARE was a Christian who invited him along to the (high Anglican) church he attended. Donald accepted the invitation and over time, through the patient pastoral engagement of the vicar (who had himself been a scientist before entering the ministry), entered a renewed and deeper understanding of Christianity. He now had a passion to serve his Saviour and carry out excellent scientific research (the latter being a manifestation of the former); but his previous experience gave him a life-long distaste for anything that smacked of a 'God-of-the-gaps' approach to the relation between Christianity and science. His thinking on the relation between theology and science was developed and refined through interaction with Prof. Rayer Hooykaas (Professor of the History and Philosophy of science at Utrecht University) with whom he became close friends. He thereby came to distinguish between a solid biblical foundation to one's thinking, and what he termed 'rationalistic biblicism.'[15]

While working at ARE on high frequency electronics MacKay noted that what could be achieved with these systems had physical limitations analogous to those of quantum physics and that the things measured were related in a complementary manner. These limiting factors he termed 'quanta of information.' Further discussion and reflection caused him to consider that the logical atomism of Wittgenstein's *Tractatus Logico-Philosophicus*[16] was well suited to

13 MacKay, V. *op.cit*. This is a little strange given his familiarity with the work of Eddington, *The Nature of the Physical World* which is basically a work of philosophy.

14 MacKay, V. *op.cit.*

15 MacKay, D.M. *The Clockwork Image*, London: IVP (1974).

16 Wittgenstein, L.*Tractatus Logico-Philosophicus*, 2nd edition. London: Routledge (2001).

the logical analysis of information.[17] This then led him to think about what could be considered 'complementary relations' more generally. MacKay's basic idea is that two descriptions are complementary 'if they refer to the same object, each is in principle exhaustive, yet they make different assertions because the context of the concepts used are mutually exclusive, so that significant aspects referred to in one are necessarily omitted from the other.'[18] Over time he applied this idea of complementarity to information theory, artificial intelligence and neuroscience, as well as science and theology.[19]

There is a view, still prevalent, that human beings can be accounted for purely as material objects: that the mind is simply (or nothing but) the operations of the brain in one way or another. This position MacKay referred to as 'nothing-buttery', and argued that it is clearly undermined by complementarity. It is not brains that think, but persons! In assessing the relation between mind and body, complementarity means that the physical and mental aspects of humans are correlated but not identical. He did not consider dualism as incoherent, just unnecessary. This he referred to as 'duality without dualism' and related it to the unity of man as described in Genesis 1 and 2. As such there is a hierarchy in the complementary relations: the thinking person is higher than the brain activity.[20] We will look at Complementarity more closely in section 2.1.

After the war he took up a post as Lecturer in Physics at King's College (part of the University of London) where he continued his research in information and Computing, which in his case was Analogue Computing (for which he received a Ph.D. in 1950). This was a time when scientists were becoming interested in whether machines could be made to behave like humans and 'think' for themselves. (The term 'Artificial Intelligence' had not yet been coined. That did not happen until the Dartmouth Conference in 1956, at which MacKay was a British delegate.[21]) The discussion was mainly focussed around the new digital computers, but MacKay was not convinced that that was the correct way to look at the problem: ' . . . being an analogue man . . .'.[22] He did not think it was entirely correct to think of it as exactly analogue either, but as some form of hybrid system. These days

17 MacKay, D. M. *Information, Mechanism and Meaning*, Cambridge MA: MIT Press (1969).

18 MacKay, D. M. 'Complementarity II', *Proceedings of the Aristotelian Society* suppl. vol XXXII (1958): 105–122.

19 As an aside: MacKay is often credited with proposing the definition of Information as 'A distinction that makes a difference', usually cited as D. M. MacKay, *Information, Mechanism and Meaning*. However, neither I, nor anyone else that I am aware of has yet been able to find evidence that he did coin that definition. Nonetheless, it is a good definition since it directly contrasts with the description of being uninformative as 'a distinction without a difference'.

20 MacKay, D. M. *The Clockwork Image*, p 106.

21 McCorduck, P. *Machines Who Think*, 2nd ed. London: Routledge (2004).

22 McCorduck. *op.cit*.

we are used to hearing about the successes of Machine Learning (especially 'Deep' Learning) but what is not generally known is that one of the earliest Machine Learning systems was built by MacKay at King's College in the late 1940s. It was basic by today's standards, but it could adapt its behaviour, based on observations, to successfully drop ball-bearings on a target.[23] MacKay was open to the idea that an artificially intelligent artefact could be built; he likened it to *pro-creation* rather than any notion of creation (thereby avoiding the claim that AI was 'playing God.')[24]

In the late 1940s a group of young researchers around London got together to discuss ideas in cybernetics and philosophy of science. They called themselves 'The Ratio Club' and included, as well as MacKay, Alan Turing and Grey Walter. No professors were allowed to join in order to allow free discussion (it was felt that someone at professorial level would have an unfair advantage in these discussions). Also at this time he was part of a seminar on the nascent Philosophy of Science started by Sir Karl Popper and had a four month residence in the Spring of 1949 at which he had almost daily discussions with the retired philosopher Sir Walter Moberly as well as meeting Michael Polanyi. These interactions undoubtedly had a strong influence on forming MacKay's understanding and appreciation of, as well has his approach to, philosophy.[25]

At one of the meetings of the Ratio Club, MacKay presented a paradox that he had come across. He had devised a thought experiment in which he considered a scenario where one might try to get a picture of a person's brain by means of what he called a 'cerebroscope.' From his deliberations on this thought experiment he concluded that 'there does not exist a complete specification of a person's brain state that they would be correct to believe and incorrect to disbelieve.'[26] This led to the formulation of logical indeterminism, and we shall explore this idea in detail in section 2.2.

As a young lecturer at King's College he learned the effect of a 'word in season'. The Christian staff in the college would meet for lunch from time to time, and on one occasion the professor of New Testament, R. V. G. Tasker, enquired concerning what evangelicals actually believed. MacKay suggested that he could find out firsthand by going to hear Martyn Lloyd Jones who was giving a talk in the College organised by the Christian Union. Tasker attended the meeting, his thinking was changed and he espoused evangelicalism. He went on to edit the IVP Tyndale New Testament Commentary series.[27]

23 MacKay, D. M. *Information, Mechanism and Meaning.*

24 MacKay, D. M. *The Open Mind and other Essays: A Scientist in God's World*, 1st ed., ed. Melvin Tinker London: IVP (1988).

25 MacKay, V. *op.cit.*

26 MacKay, D. M. 'The logical indeterminateness of human choices', *British Journal for the Philosophy of Science* 24 (1973): 405–408.

27 MacKay, V. *op.cit*.

During this time he met and fell in love with a fellow physicist, Valerie Wood. The two were married in 1955 and started a family, which eventually consisted of two boys and three girls. Four of them followed in the broadly scientific footsteps of their parents while one became an accountant (showing that his business acumen was also passed to the next generation).

While at King's, his interest in the relation between science and religion grew and he became engaged with the Research Scientists Christian Fellowship (RSCF). This organisation had started in the early 1940s under the leadership of Oliver Barclay. MacKay's involvement had such an influence on the group that one recent commentator could write 'Only after a young brain scientist named Donald M. MacKay joined the group in 1948 did the RSCF find its message of the complementary relationship between science and Christianity.'[28]

MacKay had a strong Reformed view of God's sovereignty. One other reason that he rejected a 'God-of-the-gaps' approach was because he understood that God is active in every moment 'upholding all things by the word of His power' (Heb. 1:3) For God a miracle is no harder, or different in principle, from his normal operation moment by moment.

As his thinking developed, he became more interested in understanding the one intelligent being to whom we have ready access (humans) rather than trying to create artificial ones. In 1951 the shift to neuroscience was completed after he spent a year as a Rockefeller Fellow in the United States. He still continued to work in the physics department at King's, but in 1960 he was head-hunted by the newly established Keele University to fill the research chair endowed by Granada television: 'The Granada Chair in Communication' (the name was later changed to 'Communication and Neuroscience') a position he held till his retirement in 1982. A building on the Keele University campus is named in his honour.[29]

Professor and Later Years

At Keele he established a world leading interdisciplinary team studying the sensory communication systems of the brain. An example of this is one of Donald and Valerie's last set of experiments. Roger Sperry had won the Nobel Prize in Medicine and Physiology for his work on 'split brain syndrome' which occurs in patients who have the bundle of nerve fibres joining the two hemispheres of the brain (the Corpus Collosum) severed as

28 Rios, C. M. *After the Monkey Trial: Evangelical Scientists and a New Creationism* New York, NY: Fordham University Press (2014).

29 Evans, *op.cit.*

a treatment for epilepsy. Sperry speculated, based on his experimental results, that doing this created 'two persons in one cranial space.' Donald and Valerie set out to test this hypothesis and found that while the two sides of the brain could be made to compete, this could only be pursued so far, and ultimately the unity of the person would shine through.[30]

Throughout his academic career MacKay engaged with philosophers and theologians on issues related to the mind/body problem and the relation between science and theology, to which he made significant contributions. In all his dealings with others, whether in conversation or debate, he sought to bring glory to Jesus by conducting himself as a Christian gentleman. This is clearly demonstrated in a televised discussion with B.F. Skinner (the major proponent of Behaviourism in the 20th century).[31] About three quarters of the way through, Skinner is perceived by the host, William Buckley Jr, to be struggling, and he starts to pounce on him. At this point MacKay steps in and provides Skinner with a graceful way out; it didn't help Skinner's argument but it preserved his dignity. He, and his work on the brain, was the subject of a BBC documentary as part of a series: *God and the Scientist*.

MacKay's reputation continued to grow over the rest of his career. This resulted in his receiving an increasing number of responsibilities and accolades. Examples of these reflect the breadth of this respect. As well as being the founding editor of two major scientific journals (Experimental Brain Research and Biological Cybernetics) he was an international member of the neuroscience group at MIT, foreign member of the Royal Netherlands Academy of Arts and Science, and recipient of the Heinrich Helmholtz Prize for Distinguished Research in the Cognitive Neurosciences. But it is in the domain of science and religion that his lasting legacy resides: he gave a number of invited and named lectures on the subject[32] and the last of the accolades he received was in this area.

In 1986, while he was suffering from the cancer that would soon take his life, MacKay gave the Gifford lectures at the University of Glasgow. As with all his endeavours he took the remit specified by Lord Gifford in his bequest very seriously. This meant that in presenting his ideas in their Christian context he refrained from making use of Special Revelation and focussed exclusively on the science and what he considered that could tell us

30 MacKay, D.M. & MacKay, V. 'Explicit dialogue between left and right half-systems of split brains', *Nature* 295 (1982): 690–691.

31 This debate is available on YouTube (https://youtu.be/1DMyDYgxFlo).

32 e.g. The Riddle Lectures (Newcastle), London Lectures in Contemporary Christianity, The Henry Drummond Lectures (Stirling), as well as series at Oxford, Cambridge, Johns Hopkins and Waterloo.

about humans, God, and freedom. His diligent adherence to the specification was noted by the chair, Neil Spurway.[33] These lectures formed the content of his final book, *Behind the Eye*, edited by his widow Valerie.[34]

Donald MacKay ended his earthly sojourn and entered the presence of the Saviour he had served so well in March 1987. As Paul Helm wrote:

Those Christians who knew Donald personally give thanks to God for the life and gifts that he gave to him. It was a privilege to see at work someone who was so wholly committed to the obedient service of his Maker and who so readily recognised his sovereignty over his own life and the whole of creation.[35]

Main contributions to Theology & Science

In recent years it has become common to hear calls for more scientifically informed theology, and in response, for more theologically informed science.[36] With regard to both these MacKay's contributions are clear: his church and theological background certainly informed his approach to science, and being first and foremost a scientist in his professional life, his philosophical and theological ideas arose from his scientific reflection.

The breadth and depth of his contributions to theology & science make it impossible to cover them in detail. Further exploration and analysis may be found in the theses by David Norman[37] and the author[38] or by consulting the primary sources. In this section I shall present an overview of MacKay's main contributions to theology & science.

Complementarity

We gave MacKay's basic definition of complementarity in section 1.2. It comes in two forms: non-hierarchical and hierarchical, of which the latter is the one that he spent most time discussing and developing. A straightforward example of the former is the possible projections of a three dimensional object onto a two dimensional plane.[39] Here, unlike in a photograph, every point in the

33 This is from my memory of attending those lectures.

34 MacKay, D.M. *Behind the Eye*, Oxford: Blackwell (1991).

35 Helm, P. *op.cit*.

36 Messer, N. Science in Theology: Encounters between Science and the Christian Tradition, London: T & T Clark (2020).

37 Norman, *op.cit*.

38 Coghill, G.M. 'A Critical Analysis of Donald M. MacKay's Contribution to Theology and Science.' (master's thesis, Edinburgh Theological Seminary & University of Glasgow, 2023).

39 Or from any n-dimensional space onto a lower dimensional space, such as is routinely done

object is projected onto each plane, hence each two dimensional plane is complementary to the others. In each plane all the information about every point is retained, what is lost is the information about the relationship between (some of) the points.[40] This observation resonates with more recent development in the philosophies of science and information, such as the perspectival realism of Massimi[41] or Floridi's levels of abstraction.[42]

The second kind of complementarity, *hierarchical*, is based on the relation between descriptions from different domains in particular, the physical and the informational. That is, for example, one can have a message written somewhere (one of MacKay's favourite examples was a billboard of lights), such as *'Vegetables are good for you'*. This message could be exhaustively analysed in the language of physics, say, by a physicist or engineer. They could talk about the electrical and mechanical properties of the bulbs, their spatial distribution etc. without saying anything about the message being communicated. Similarly, a linguist could interpret and describe the message with respect to its semantics in accordance with the rules of the language, without any mention of the physics of the situation. Here the message can be said to be *embodied* in the physical array of bulbs, and each description is complete with respect to its own domain. The hierarchy is such that the informational sits above the physical because one cannot change the meaning of the message without the physical layout having to change, whereas one can change, to some degree at least. the physical layout without changing the message: for example if some of the bulbs were to fail.

From this it was a short step for MacKay to consider how this might apply to the mind/body problem. There were at least three things that influenced MacKay in this regard. As well as the complementarity, already established, between the physical and the informational, there was the unity of a human (*nephesh*) as described in Gen. 1, and the fact that it is persons, not brains, that think.[43] In this, as noted previously, he was responding to the ontological reductionism prevalent in the middle of the 20th century.[44] MacKay did not consider *dualism*, as put forward in recent times by for example Eccles and Popper,[45] to be in any way incoherent. He simply did not think it was necessary to posit two substances in order to

in data science to make problems more tractable.

40 MacKay, D.M. 'What makes a contradiction?', *Faith and Thought: The Journal of the Victoria Institute* 97 (1968): 7–14.

41 Massimi, M. *Perspectival Realism*, Oxford: OUP (2023).

42 Floridi, L. 'The method of levels of abstraction', *Minds and Machines* 18 (2008): 303–329.

43 MacKay, D.M. 'The sovereignty of God in the natural world', *Scottish Journal of Theology* 21 (1968): 13–26.

44 Recall, this is what caused him to coin the term "nothing-buttery".

45 Popper, K. and Eccles, J. *The Self and its Brain* London: Routledge (1984).

account for the duality between mind and brain. This he termed 'duality without dualism'.[46]

It does not take much to be struck by the similarities between MacKay's complementarity and *supervenience*. The standard definition of supervenience is almost identical to the basic understanding of hierarchical complementarity, namely '[a] set of properties A supervenes upon another set B just in case no two things can differ with respect to A-properties without also differing with respect to their B-properties.'[47] However, given the multiple versions and applications of complementarity given above, it is arguable that it is more general than supervenience. One unfortunate side effect of using the term complementarity is that in his earlier papers MacKay had to spend a significant amount of time defending his use against criticism that it was not in line with Bohr's use of it in quantum mechanics (sometimes nearly fifty percent of the paper).[48] This may be why latterly MacKay changed to calling it *Comprehensive Realism* instead.[49] Had he done so from the beginning people might have been discussing and developing his ideas instead of Davidson's 'supervenience'.[50]

Logical Indeterminism

Debates on the issue of free will and determinism are still very much alive, especially since Peter van Inwagen published a paper in 1975 purporting to show the incompatibility of free will and determinism.[51] In fact it is probable that more papers have been published on the subject since then than for several centuries prior to that. Nonetheless a majority of philosophers (in the analytic tradition at least) remain determinist.[52] Amongst the plethora of responses, there are both *compatibilist* and *incompatibilist* versions,

46 MacKay, D.M. 'Ourselves and our brains: Duality without Dualism', *Psychoneuroendocrinology* 7, no. 4 (1982): 285–294.

47 Horgan, T. 'Supervenience', in *The Cambridge Dictionary of Philosophy*, ed. Audi, R. Cambridge: CUP (1995), 778–779; McLaughlin, B. and Bennett, K. 'Supervenience', in *The Stanford Encyclopedia of Philosophy (Summer 2021 Edition)*, ed. Zalta, E.N. (Stanford University, 2018). https://plato.stanford.edu/archives/sum2021/entries/supervenience/.

48 The irony here is that Bohr may well have borrowed the term from 19th C. psychology; see Busemeyer J.R. and Bruza, P.D. *Quantum Models of Cognition and Decision*, Cambridge: CUP (2012).

49 In his final book, *Behind the Eye*, he does not use the term at all.

50 Davidson, D. 'Mental Events', in *Experience and Theory*, 1st, ed. Foster L. and Swanson, J. W. Clarendon Press (1970), 207–224.

51 van Inwagen, P. 'The incompatibility of free will and determinism', *Philosophical Studies* 27 (1975): 185–199.

52 Bourget, D. & Chalmers, D.J. 'What do philosophers believe?', *Philosophical Studies* 170 (2014): 465–500.

covering a wide variety of proposals. The interested reader is directed to Helen Beebee's comprehensive work on the subject.[53]

One of the basic compatibilist solutions is to note that the problem can be framed as a conditional, such that if an agent were to try to do otherwise, they would succeed. Since this is a conditional, even though determinism dictates that they do not do otherwise, the conditioned remains true, and hence they are deemed free. Even superficially this seems like sleight-of-hand since at face value it applies as much to inanimate objects as to sentient agents.

On the other side a basic proposal for incompatibilism relies on 'randomness' playing a part in the decision process to adjudicate between possibilities. While this may provide a means of arguing for indeterminism, it is not clear how it helps with free will. A key feature of human freedom is *control*,[54] and randomness here would appear to remove that aspect. Another direction was to look at the problem in modal terms. Again this has incompatibilist and compatibilist versions. On the incompatibilist side Plantinga, for example, advocates a form of libertarian free will based on Molinism.[55] On the other hand List has proposed a compatibilist-libertarian approach utilising modal logic to separate what he refers to as the physical and agential level.[56] It is into this melee that we introduce MacKay's proposed solution. The disappointing thing here is that despite the, sometimes frenetic, activity, and despite the fact that than MacKay's proposal was matured prior to van Inwagen's paper, there has been little or no interaction with his work on this subject since his death.

Logical indeterminism (LI) is the most controversial of MacKay's ideas, possibly because it is also the one people have found hardest to understand. In an earlier section we described when and how he came up with the idea. Here I shall present an outline of the argument and the ensuing controversy. I shall also point out what I believe is a flaw in the original formulation and propose a solution which makes it more robust, by means of modal logic.

To review MacKay's approach to the problem of free will we must consider how he defined free will:

> … unless he makes the decision it will not be made, that he is in a position to make it, and that no fully-determinate specification of the outcome already exists which he would be correct to accept as inevitable, and would be unable to falsify, if only he knew it.[57]

53 Beebee, H. *Free Will: An Introduction*, Basingstoke: Palgrave MacMillan (2013).

54 Fischer, J.M. and Ravizza, M. 'Precis of Responsibility and Control: A Theory of Moral Responsibility', *Philosophy and Phenomenological Research* 61, no. 2 (2000): 441–445.

55 Plantinga, A. 'On Ockham's way out', *Faith and Philosophy* 3, no. 3 (1986): 235–269.

56 List, C. *Why Free Will is Real*, Cambridge, MA: Harvard University Press (2019).

57 MacKay, D. M. *The Clockwork Image*, p 110. It is also used as the definition of LI by Malcolm

The basic proposed mechanism and argument follows from the idea that mind and brain are in a complementary relationship. This being the case, the observation of the brain state, *B*, by means of the cerebroscope will have direct correlates in the mind, assumed one-to-one for the argument. Consider then a super-scientist, *O*, who is able to use the cerebroscope to obtain a complete map of the brain of a subject, *S*. They would then have a complete specification of *S*'s brain state, *B*. Now, consider someone (again *S*) using the cerebroscope to try and obtain a complete picture of their own brain.[58] This might be possible to a degree, but there would always be one part they would not be able to specify: the part where they were stored the specification itself.[59] That is, the specification of *B* does not exist for *S*.[60]

From this observation, which seems straightforwardly correct, MacKay went on to consider what might happen if hard determinism were the case.[61] In such a case the super-scientist, with the complete specification *B* and knowledge of the input to *S* could predict what action, *A*, they would perform in their immediate future. That is, *O* could make the argument: If *B* then *A*. *B* is the case, therefore *A* will happen. Here MacKay draws a very clear distinction between an event being logically indeterminate and unpredictable by anyone.[62] The super-scientist can accurately predict *S*'s action in the situation where *S* is not informed of the prediction.

MacKay then asks whether this prediction would have an 'unconditional claim to the assent' of *S*, such that they would be 'correct to believe it and incorrect to disbelieve it'. That is, is the action *A* inevitable for *S*? His answer is that it is not. The reason for this has two parts. In order for *S* to have the means to believe the prediction, they must be informed of its content. However, if that is done then a) the act of communication would change their mental state, and hence their brain state *B* (on which the prediction was based) renders the prediction obsolete, and b) as noted previously, *B* does not exist for *S*, so any prediction based on it will not be such that *S* would be 'correct to believe it

Jeeves in his presentation of of MacKay's ideas: Jeeves, M.A. *Psychology and Christianity: the View Both Ways*, 1st ed. London: IVP (1976).

58 What an external observer might be able to say about the brain state, MacKay referred to as the "O-story" (for 'outside' or 'observed') in distinction to what a subject could say about themselves ('I see', 'I feel', etc.) which he called the "I-story" (for 'inside' or 'I').

59 MacKay, D. M. *Behind the Eye*, p114.

60 A useful physical analogy is what happens if one has a system with a mic connected to an amp, which is connected to a loudspeaker, and one places the mic in front of the loudspeaker. The ensuing howl is due to the positive feedback that cannot stabilise (and the volume is only limited by the capacity of the system).

61 Though it must be emphasised that MacKay was not in any way committed to the truth of determinism. This is simply a 'what if' thought experiment.

62 That is, this is a logical argument, not a physical one.

and incorrect to disbelieve it'. Thus, since there is one person in the world for whom it does not have a claim to their assent, the prediction is not inevitable, and so *S* has free will. Something else which follows from this is that *after the event A* has taken place, *S* could be shown the prediction and would, from that temporal vantage point, be correct to agree with the prediction. This is MacKay's principle of logical relativity.

Over a period of decades there were several responses to MacKay's argument. Many of those pivoted on severe misunderstanding: e.g. seeing it as an attempt to revive the medieval 'two fold view of truth',[63] confusing freedom and unpredictability,[64] equating it with speed of computation,[65] that future brain states are uncaused,[66] and that LI is inherently self-contradictory.[67] And MacKay dispensed with those quite easily. Others demonstrated a misunderstanding, but the discussion led him to clarify things.[68] Only one exchange, that I am aware of, came close to being a significant critique, that of William Hasker.[69] The outcome was Hasker taking on board some of MacKay's corrections but finally commenting that MacKay's position resulted in a tautology, from which nothing followed. This would not have bothered MacKay since a tautology as output is the ultimate in openness. Here, in the exchange there was, it seems to me, an extent to which they talked past one another. In the end, during his Gifford lectures, MacKay felt able to claim that his arguments had withstood nearly four decades of criticism and he was confident in them. Nonetheless, I think there is a flaw in his argument for LI.

The flaw is that as MacKay states his argument it is guilty of the *modal fallacy*: that is, it associates inevitability (or necessity) to the consequent

63 Clark, G.H. *Behaviorism and Christianity*, 1st ed. Jefferson, MD: Trinity Foundation (1982).

64 McDermott, J. 'I'm free because I don't yet know what I'm going to do', *British Journal for the Philosophy of Science* 23 (1972): 343–346.

65 Good, I. J. 'Free will and the speed of computation', *British Journal for the Philosophy of Science* 22 (1971): 48–49.

66 Thalberg, I. 'New light on brain physiology and free will?', *British Journal for the Philosophy of Science* 21 (1971): 379–383.

67 de Witt, L. W. 'The hidden assumption in MacKay's logical paradox concerning free will', *British Journal for the Philosophy of Science* 24 (1973): 402–405.

68 Williams, C. J. F. 'Logical indeterminacy and free will', *Analysis* 21 (1960): 12–13; Watkins, J. N. W. 'Freedom and predictability: an amendment to MacKay.', *British Journal for the Philosophy of Science* 22 (1971): 263–275; MacKay, D.M. 'Divine activity in a scientific world', *Faith and Thought: The Journal of the Victoria Institute* 91, no. 2 (1960): 75–96; MacKay, D.M. 'Choice in a mechanistic universe: a reply to some critics', *British Journal for the Philosophy of Science* 22 (1971): 275–285.

69 Hasker, W. 'MacKay on being a responsible mechanism: Freedom in a clockwork universe', *Christian Scholar's Review* 8 (1978): 130–140; MacKay, D.M. 'Responsible mechanism or responsible agent: a reply to William Hasker', *Christian Scholar's Review* 8 (1978): 141–148; Hasker, W. 'Reply to Donald MacKay', *Christian Scholar's Review* 8 (1978): 149–152.

of the conditional statement rather than the whole conditional itself (the consequence)[70] Once one recognises this, the argument fails because then the prediction is conditional, and hence the consequence has an 'unconditional claim to the assent' of everyone, S included.[71] The fact that the argument is fallacious does not mean that the conclusion is false. In the case of LI, recognising that 'inevitable' is a modal term suggests that we might be able to reformulate the argument in modal terms, in particular Kripke's 'many worlds' semantics. It turns out that this is indeed the case. For the outcome (prediction) to be inevitable (necessarily the case), it would have to be true in all possible worlds. However, there exists at least one possible world where that is not the case: the world in which S is informed of the prediction. Hence LI does constitute a robust, compatibilist, argument for free will, albeit in a revised modal form.[72] This version of the argument avoids the modal fallacy because each scenario takes place in a different logical world and is based on the consequence.

There is nothing in MacKay's LI that suggests that *S* will necessarily *not* do what *O* predicts even if informed of it. The fact that the future is really open for them means they could still do *A*. It depends on how strongly they feel about or are committed to the action. Consider a trivial example. In this scenario I am about to have breakfast at a hotel. Our super-scientist has been observing my brain and predicts that I will not have beans with my 'full English'; and informs me of the prediction. Now since I do not like beans with a full English there is no way I will have them and the prediction would be fulfilled despite my having been informed of it. On the other hand, if the prediction were that I was going to have muesli, then there is a strong possibility that I would have porridge instead, just to be contrary and foil the prediction. Both of these scenarios are acceptable because according to LI the future remains open until the decision has been made.

MacKay subsequently went on to apply his findings to the knotty theological question of predestination and human responsibility. He saw that the same principles of logical relativity applied to God's sovereignty and human freedom. The conclusion is the same: that although God is absolutely sovereign over his creation, human actions are not inevitable, for the same reasons as before. In this way MacKay thought he had found a way to reconcile Calvinist and Arminian approaches to the issue.[73]

70 This fallacy was known at least as far back as Aquinas.

71 And conversely, if it does not have a claim to the assent of *S* it has no claim to the assent of *O* either.

72 The details of this argument are outside the scope of this paper. The full version can be found in Coghill, G.M 'A Critical Analysis of Donald M. MacKay's Contribution to Theology and Science.' and Coghill, G.M. 'On the modal indeterminacy of a free choice', *forthcoming*, 2024.

73 MacKay, D. M. *The Clockwork Image*, Chapter 8.

The main focus of MacKay's original work was on individuals, but later he went on to explore how these principles would apply to agents in dialogue. Here he posited two super-agents, each with a cerebroscope to observe the other's brain state. In this case the two agents form a single coupled system, and so each agent cannot obtain a complete specification of the other agent brain state nor obviously, of the system as a whole. This also has theological implications. For God to be the author and upholder of all that is (God-as-author as MacKay calls him) and to be in dialogue with his creation, whether by speech or incarnation (God-in-dialogue) requires that God be multi-personal since the same person could not perform both functions on pain of incoherence. This does not go as far as showing that God is a Trinity which MacKay acknowledges can only be discovered by means of special revelation, but it does provide a rational basis for such.[74]

Other contributions to Theology & Science

While most of MacKay's efforts in the domain were focussed on defending complementarity and LI, he also contributed to other questions relating to theology and science, though the foundations of complementarity and LI were never far away. In this section we see his outlook on creation and miracle, and artificial intelligence. The former brings to the fore his theological position, and the latter reflects his early pioneering work in the area.

Creation, Evolution, and Miracle

What MacKay said about issues of creation and miracle, was very much in line with his overall view of God's works of creation and providence. As he would have been taught as a child from the Westminster Shorter Catechism: 'The work of creation is, God's making all things of nothing, by the word of his power, in the space of six days, and all very good.' and 'God's works of providence are, his most holy, wise, and powerful preserving and governing all his creatures, and all their actions.' God-as-Author upholds all things moment by moment (Heb. 1:3), therefore a miracle is no harder for God than what we see as the normal operation of the universe. God does not need to find ways to interact with the universe: he writes, or re-writes, the narrative in accordance with his overall plan.

MacKay did not say very much about the relation between creation and evolution, but he did state that he could see no biblical reason for the rejection of the scientific theory of evolution. He applied his view of God's providential oversight by observing that Gods last act of creation is presented in Genesis 3: '.

74 MacKay, D. M. *Behind the Eye*, p 211.

. . Cursed is the ground because of you . . .'. That is God re-writes the narrative such that '. . . the creation was subjected to futility . . . will be set free from its bondage to corruption . . . the whole creation has been groaning together in the pains of childbirth until now.' (Rom 8: 20–22). Therefore it should not surprise us that we observe 'nature red in tooth and claw', and that the scientific evidence points to evolution. The Bible does not preclude that. He did, however, caution that one should be wary of hitching one's wagon to any particular theory of origins, since scientific theories are always tentative and it will not matter for Christianity which, if any, theory turns out to be true.[75]

The same applies to miracles. What we consider scientific laws are descriptive, not prescriptive, therefore a miracle is simply part of God's overall narrative to teach us something about himself. MacKay identifies three kind of miraculous event presented in scripture: 1) miracles of timing (e.g. the crossing of the Red Sea), 2) miracles with an apparent scientific explanation (e.g Jesus' turning water into wine) and 3) those for which there is no scientific explanation (e.g. the resurrection, which is the first fruits of the new creation, and a different order of reality).[76]

MacKay explains his understanding of the relation between theological and scientific explanations by means of an illustration. He asks us to consider something like a TV screen, say an iPad. The pixels on the screen are maintained and refreshed at 90 Hz by the electrical power source. Now consider an artist drawing a sequence of scenes to depict an ongoing cricket match. Assuming the depiction is done in a rational and coherent manner, an observer looking at the screen could, in principle, describe the physics of the scenario. This may well be complete in itself, but would in no way conflict with the fact that the whole scenario was upheld by the artist (who would not themself be part of it). That is, the two perspectives are hierarchically complementary.[77]

Artificial Intelligence

We have already noted that MacKay was a pioneer in the early days of AI, in fact before the domain had acquired a name. He was very much an 'analogue man'[78] and remained sceptical about the possibility of creating a true AI by digital means, or more specifically by 'rule following' because when he was most closely involved with the domain, symbolic AI (digital based rule following) did not have much in the way of uncertainty handling.

75 MacKay, D. M. 'The sovereignty of God in the natural world'; MacKay, D. M. *The Clockwork Image*.

76 MacKay, D. M. *The Clockwork Image*, chapter 6.

77 MacKay, D. M. pp 58–60

78 McCorduck, *op.cit.*

However, even during his life time, pure analogue computing was running out of steam and digital (symbolic) computing had moved on from being simply rule-following engines. Uncertainty was being incorporated into digital systems by means of, for example, Bayesian nets and fuzzy logic. In fact today, those star examples of AI, deep neural nets (which for MacKay would have been the epitome of an analogue system), are implemented on digital devices.[79]

In assessing the status of AI, or claims to AI, MacKay asks for care in distinguishing between actual cognitive agency and imitation (of behaviour). When one considers an actor playing a part, Hamlet say, MacKay asks how many persons are on the stage. The answer is, of course, one. There are not two persons: the actor and Hamlet, there is just the actor playing the part of (imitating) Hamlet. No matter how sophisticated the behaviour of a rule following device, that would not be sufficient in and of itself to constitute real intelligence any more than the behaviour of the actor indicates the presence of Hamlet.[80]

However, he did not consider it a logical impossibility that an artificially intelligent agent could be produced. He did not think this was in any way encroaching on God's domain; rather he likened it to *procreation* which takes place by natural (and pleasurable) means very regularly. If the production of a really intelligent entity were to occur it would need to be by means of a hybrid of analogue and digital engineering. He was sceptical that it could be done with silicon based approaches, suggesting that some kind of 'wet' engineering might be required.[81] In fact we are now starting to see moves in this direction with the creation of neural nets constructed from laboratory grown neurons.[82] However, along with more recent philosophers, such as Luciano Floridi,[83] he thought it highly improbable that sentient AI would ever become a reality.[84]

Concluding Comments

It is now time to reflect on MacKay's contributions as they relate to the current state-of-play in ongoing debates in religion and science, and analytic philosophy of religion. Each of the topics he wrote on, as described in this paper, is a

79 Though some would see them all as more properly called informational rather than digital: Floridi, L. *The Philosophy of Information*, 1st ed. Oxford: OUP (2011).

80 MacKay, D. M. *The Open Mind and other Essays: A Scientist in God's World*, Chapter 9.

81 MacKay, D. M. *Behind the Eye*.

82 Pavlou A. and Lieberth, T.S.K 'An organic artificial spiking neuron for in situ neuromorphic sensing and biointerfacing', *Nat. Electron*. 5 (2022): 774–783.

83 Floridi, *op.cit.*

84 As distinct from the sophisticated technological devices currently grouped under the rubric of 'artificial intelligence'.

live issue, though his contributions to each of them are not all at the same level. Therefore to bring this paper to a close I shall highlight where each topic fits in the current landscape, and suggest how MacKay's work could, and should, be further explored to enhance the various debates. This is not, it must be emphasised, a suggestion that his views in these areas were complete, or beyond criticism. No philosopher or theologian has achieved that position (no matter what their acolytes might think).

Perhaps foremost in this regard, is his proposal regarding the relation between determinism and free will. The ongoing debate does not show any sign of abating any time soon. Recent developments in the field have seen more people resorting to a modal argument (e.g Plantinga and List). In this regard a modal version of MacKay's LI works and could indeed provide a means of bridging the gap between libertarianism and determinism (as aimed for by List and Crisp for example). An additional aspect here is that the basis of LI also has implications for models of the Trinity that are ripe for exploration.[85]

His first discovery was complementarity. This, as noted, is more general than the current popular approach of supervenience. In recent times some theologians have adopted supervenience to accommodate the mind/body relation within what is essentially a physicalist framework, such as Murphy's 'non-reductive physicalism'[86] MacKay would have eschewed such a relation. There is nothing in the idea of complementarity that necessitates any kind of physicalism.[87] There is certainly a need for embodiment, but that is a different thing: for example MacKay suggests that the spirit of a human is embodied in (and thus complementary to) the mind.[88]

The complementarity of theological and scientific description is captured by his illustration of the cricket match. The similarity of that to the occasionalism of Malebranche[89] has not gone unnoticed.[90] No one has claimed that MacKay was an occasionalist, but the recent interest in and proposals towards some kind of occasionalism, by Gordon Clark[91] and Alvin Plantinga[92] for example,

85 Coghill, G.M. 'A Critical Analysis of Donald M. MacKay's Contribution to Theology and Science.'

86 Murphy, N. 'Physicalism without reductionism: Towards a scientifically philosophically, and theologically sound portrait of human nature.', *Zygon* 34, no. 4 (1999): 551–571.

87 Strictly speaking there is nothing in the concept of supervenience that necessitates physicalism either.

88 MacKay, D. M. *The Open Mind and other Essays: A Scientist in God's World*, p71.

89 Malebranche, N. *The Search after Truth*, ed. tr. Lennon T. M. and Olscamp, P. J. (Cambridge: CUP (1997)

90 Garvey, J. 'The Real MacKay', 2016, https://potiphar.jongarvey.co.uk/2016/07/24/the-real- mackay/.

91 Clark,G.H. *Lord God of Truth*, Jefferson MD: The Trinity Foundation (1986).

92 Plantinga, A. 'Law, cause and occasionalism', chap. 6 in *Reason and Faith: Themes from Rich-*

make it an interesting potential line of enquiry to seek to identify the relation between occasionalism and complementarity.

Another aspect of the relation between theology and science is his proposed solution to the biblical and scientific description of origins. While it is not strictly a form of complementarity, it does tie in with that approach. His proposal was at the time a fairly unusual one, though it did have a related precursor in the work of Gosse[93] (for whom MacKay expressed some sympathy[94]). But more interestingly it is itself a precursor to more recent proposals such as that of Hud Hudson,[95] who argues that a distinction between time and hyper-time allows for both a literal six days creation and the extended timescales needed for evolution, and the view of Dembski,[96] who also sees the fall as having cosmic effects that 'travelled' both forwards and backwards in time.

Given these considerations it should be clear that MacKay was an innovative thinker and contributed ideas across a wide range of issues related to religion & science, and theology. It is not altogether clear why his contributions have not received the attention they deserve since his death, and it is not very helpful to speculate. However, I hope that the outline presented here will inspire others to explore his ideas and arguments in greater depth.[97]

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ard Swinburne, ed. Bergmann M. & Brower J.E. OUP (2015), 126–144.

93 Gosse, P.H. *Omphalos: an Attempt to Untie the Geological Knot* Paternoster Row, London: London: John van Hoorst (1857).

94 Donald M. MacKay, 'Science and Christian Faith Today', in *Real Science, Real Faith*, ed. R. J. Berry (Monarch, 1991), 88–97.

95 Hudson, H. *The Fall and Hypertime*, 1st ed. Oxford: OUP (2014).

96 Dembski, W.A. *The End of Christianity*, Paternoster: Milton Keynes (2009).

97 For anyone who is interested in pursuing MacKay's thought further, as well as the works cited here, a full bibliography of MacKay's writings has been produced by McDonald, M. 'Donald MacCrimmon MacKay (1922 – 1987): A Bibliography', 1994, https://www.asa3.org/ASA/articles/MacKay_bib.html.