# Dying to Live: Biology and Faith

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Abstract

This paper explores the notion of dying-to-live, as it finds currency in biological processes and in a theological account of growth in holiness for the Christian.

Orientation towards death is a familiar feature of classical Catholic art depicting sainthood. It is also a theme of philosophical reflection. Spinoza's Free Man must think of dying. Heidegger's Dasein can only exist as "being-toward-death" if he is to be authentic. Amongst theologians, Teilhard de Chardin understood biological death to be pivotal in the transformation of nature, and in growth of the personality. Arthur Peacocke similarly identifies biological death as the sine qua non of evolutionary emergence. At the level of a single organism, Claude Bernard characterised two interdependent processes: self-directed organic creation and self-destruction.

"In the midst of life we are in death." The Funeral Service encapsulates in these words the biological and theological intertwining of living and dying. Three examples follow.

First, molecular death-in-life. Starvation carries the threat of death daily. The mammalian metabolic response to starvation is tripartite : glycogenolysis in hours, gluconeogenesis in days, and ketogenesis in months. All of these mechanisms of internal fuel regeneration are versions of catabolic molecular destruction. However, gluconeogenesis is distinctive in that it links destruction of muscle and adipose tissue to the creation of new glucose, the ubiquitous bioenergetic fuel. Dying and living, as destruction and creation, are here juxtaposed.

Starvation is also a good spiritual metaphor. The primordial sin of the Garden of Eden was eating the apple, and the first Deadly Sin is Gluttony! Hunger for God expresses the motive for the spiritual journey, punctuated for Christians by frequent participation in the sacraments of Penance and Eucharist, through which dying-to-self and living-to-Christ can be realised.

Second, cellular death-in-life. The pathologist Andrew Wyllie first described the process of programmed cell death, or apoptosis, now recognised as central to embryogenesis, neurogenesis, immunoregulation, inflammation and tumorigenesis. In apoptosis, organised cell deletion allows new growth, development, and indeed survival. The theme of death as the gate of life matches that of the sacrament of Baptism : ritual drowning and resurrection.

Third, tissue death-in-life. The biological process of wound healing consists of three stages : wound stabilisation by "organised" blood clot, then tissue demolition, and finally tissue regeneration and ingrowth. Tissue macrophages are dominant in remodeling wounded tissue at each stage, being both destroyers and regenerators, agents of tissue death and life, as healing proceeds.

Healing a wound is also a good spiritual metaphor. Movement from wound to wholeness captures the nature of the spiritual pilgrimage of faith. Once again, a biological process reveals destruction and creation as juxtaposed. The dual role of macrophages recalls the image of Snake in medicine, and recalls the image of the God who wounds us in order to make us more whole.

Orientation towards death is both biological and spiritual necessity. We are truly “dying-to-live” in body and soul.

Biography

*A member of the Society of Ordained Scientists, Professor Gordon McPhate trained consecutively as a physician and a priest, combining both vocations in joint pastoral and clinical academic posts at the Universities of London and St.Andrews.*

*Initially trained as a physiologist, Dr McPhate researched the role of prostaglandins and synthetic steroids in bronchodilation, while teaching physiology to medical students at Guy's Hospital, London. Subsequent to a research doctorate on the hormonal regulation of gluconeogenesis, Dr McPhate trained as an endocrinologist and chemical pathologist, becoming a hospital consultant in these fields of practise, while also teaching pathology to medical students at St.Andrews. His research field shifted to the search for protein markers of diabetic nephropathy.*

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Adam and Eve died. They were not intended for death. Death was punishment for the primordial sin they had committed, and so they were expelled from the Garden of Eden and debarred from access to the Tree of Life.[1]

As the new Adam, Christ on the Cross was in his unique death decisively victorious over the ultimate enemy Death, and broke its power over human beings for all time. In Christ, we have access to God and the Tree of Life. Eschatological fulfilment of the victory over Death is awaited, but is nevertheless assured.[2]

Christian tradition has consistently maintained a negative approach to death, although its focus has been primarily on spiritual death, rather than biological death. However, the notion that death is fundamentally punishment for sin is difficult to eradicate, even from biological death. Closely related in this context, is the notion that disease and sickness are also punishment for sin.

This paper explores the notion of dying-to-live, as it finds currency in biological processes and in a theological account of growth in holiness for the Christian. This notion contains two elements: a movement towards fuller life, but an acceptance and a recognition that the movement positively requires death and dying as a recurrent feature of its route. This notion implies that death and life are intertwined rather than mutually exclusive.

Whereas the tradition makes some distinction between spiritual and biological death, I suggest here that a more fruitful distinction can be made between death-towards-life (regarded positively) and death-towards-annihilation (regarded negatively).

Jesus himself, in the Johannine tradition, speaks of the necessity of death for spiritual growth, but using a biological metaphor: "*... unless a grain of wheat falls into the earth and dies, it remains alone; but if it dies, it bears much fruit*."[3]

Orientation-towards-death is a familiar feature of classical Catholic art depicting sainthood. For example, there are many paintings of St Jerome in simple hermit existence, accompanied by a bible, a cross, and a skull, representing the focus on death. Clearly, the focus on human mortality concentrates the mind on spiritual effort and zeal, and underscores the importance of preparing for the afterlife in discipline and self-denial. The skull is a spur to growth in holiness.

Orientation-towards-death has also been a theme of several philosophers. Benedict de Spinoza famously said: "*A free man thinks of nothing less than of death, and his wisdom is a meditation not on death but on life*".[4] For Spinoza, the free man is free precisely because he is fully aware. Part of that awareness is the insight that death is a window on life. Contemplation of death robs death of its negative power over us. Spinoza understands the authentic person to be defined in terms of awareness. Martin Heidegger understands the authentic person to be defined as a being-towards-death. A person thrown into the world (Dasein) must come to terms with the possibility of Nothing. Immersion in the world by engaging in Fallen-ness is an inauthentic way to relieve the anxiety of contemplating the Nothing. Facing the Nothing, engaging with the Nothing, is for Heidegger the only authentic way for Dasein to live; and this means living as a being-towards-death.[5]

Teilhard de Chardin also had a positive attitude towards the functional necessity of death. For him, death is neither absurd nor scandalous, and in the context of cosmogenesis is directed by the good and powerful creator God. The "death barrier" for Teilhard must be crossed if we are to develop free of limitation.[6] As Teilhard explains: "*God must in some way or other make room for himself, hollowing us out and emptying us, if he is finally to penetrate into us. And in order to assimilate us into him, he must break the molecules of our being so as to recast and remodel us.*

*The purpose of death is to bring about this opening up of our inmost selves which God desires. It will force us to undergo the disunion he is waiting for. It will put us into the state organically needed if the divine fire is to descend upon us.*"[7]

The necessity of death within the evolutionary context is a theme of Arthur Peacocke: "*Biological death of the individual is the prerequisite of the creativity of the biological order.*"[8] and "*Biological death can no longer be regarded as in any way the* ***consequence*** *of anything human beings might have been supposed to have done in the past, for evolutionary history shows it to be the very means whereby they appear, and so, for the theist, are created by God*"[8]. For Teilhard de Chardin biological death is pivotal in the transformation of nature, and in growth of the personality. For Arthur Peacocke, biological death is the *sine qua non* of evolutionary emergence. These perspectives on biological death are entirely positive and congruent.

Claude Bernard, an early doyen of experimental physiology, considered that single organisms were characterised by two interdependent processes: self-directed organic creation and self-destruction. He used the expressions "life is death" and "life is creation" to refer to these processes. By "life is death" Bernard meant that organic life was dependent upon the operation of physicochemical laws, and as such engaged in destroying itself.[9]

In his book, *God and Human Suffering* and standing in the tradition of Tillich and Niebuhr, Douglas Hall characterises death as the necessary antithesis of the "struggle to be". As Stanley Hauerwas comments on Hall's theology of death: "*All of this means that death must be part of God's good creation. What sin brought was not mere physical death but a kind of death that threatens absolute aloneness, a threat that humankind works against in positive ways.*"[10] As Douglas Hall puts it: "*(Death) is also a useful, perhaps even a necessary enemy. In this (Christian) tradition, even death must be God's servant, serving God's project, namely, the blossoming of the* ***life*** *of the world.*"[11]

Karl Rahner is also positive about the role of dying and death in the process of being saved and sacrificed. He accords with Heidegger's assessment of human existence as "being unto death", and sees every act of letting go of the self in surrender to God, every act of self-transcendence in acts of love, as part of dying. Loss is gain. However, he is keen to define the condition under which a positive view of death can be taken: "*Death is a downfall, and only by faith can this downfall be interpreted as a falling into the hands of the living God.*"[12] For Rahner, death is a threshold, a climax, a transposition, a fulfilment, and an encounter. It is to be anticipated and embraced positively. As he said in dialogue: "*There can be no doubt that for theologians and their doctrine, and for the Christian Faith, the Christ Event is not an arduous restitution of the person's paradisiacal destiny, but something far superior.*

*Forgetting all evolutionary theories and speculations, death may certainly be conceived as a positive event of life, as the triumph of absolute life in the dimension of the finiteness of the human person, a triumph which demonstrates that once more, even in the seeming absurdity of the person's depth, God and God's eternal life are victorious*."[13]

"*In the midst of life, we are in death*." So proclaims the Funeral Service of the Book of Common Prayer of the Church of England. These words can be interpreted to mean that living and dying are intertwined from both theological and biological perspectives.

The negative approach to death of the Christian tradition has been corrected to some extent by the thinking of philosophers and theologians, whose work has been briefly reviewed here. It now remains for this paper to provide biological models as evidence supportive of the notion of dying-to-live or death-towards-life. In this way, I seek to encourage a more positive attitude towards death among those who stand within the Christian tradition itself. Three models are provided, each from a different level of biological organisation: molecular level, cellular level, and tissue level. Each model has (I suggest) possible cross-relevance for theology, spirituality, and liturgy.

**Dying to Live: Molecules**

First, death-in-life is exemplified by catabolism: the metabolic conversion of a complex molecule into simpler molecules, linked to a bioenergetic gain for the whole organism and its survival. If ontological status is accorded a molecular species or entity, then in catabolism of the molecule it loses its existence, and "dies".

There are many possible instances of molecular death, but the catabolic responses to starvation offer powerful examples, given that we each live under the threat of death by starvation from day to day. The mammalian response to starvation is tripartite, as the timescale of starvation is negotiated from hours to months. In early starvation, the priority is to generate internal fuel in the form of glucose. Within hours of fasting, hepatic glycogenolysis converts storage glycogen into free available glucose, for use as fuel.

Over days of starvation, the metabolic response, co-ordinated by the catabolic hormonal milieu, continues to be dominated by the generation of glucose. However, since glycogen stores are quickly depleted, this new glucose must be synthesised from carbon skeletons derived from the catabolism of muscle protein and adipose tissue fat stores. This second process is gluconeogenesis, and occurs almost exclusively in the liver, promoted by glucagon and cortisol released into the bloodstream. Under the influence of these hormones, muscle glycogen is converted to hepatic glucose via lactate, muscle protein is converted to hepatic glucose via amino acids, keto acids, pyruvate, and alanine and adipose triacylglycerol is converted to hepatic glucose via glycerol. These are the processes of hepatic gluconeogenesis.

If catabolism is molecular death, then anabolism is molecular creation and life. Hepatic gluconeogenesis is a combination of the catabolism of muscle glycogen, muscle protein, and adipose triacylglycerol - and the anabolism of new glucose within the hepatocytes. As such hepatic gluconeogenesis is a profound instance of death-in-life: catabolism linked to

anabolism, but within the context of the threat of death by starvation, and the strategy of a bioenergetics of survival. As the strategy is worked out over weeks of starvation, there is obvious loss of muscle mass and adipose tissue deposits, and the individual is seen to be wasting away. Again, death-in-life.

Over weeks to months of starvation, the adaptive response to the crisis necessarily shifts from generation of glucose as fuel to generation of an alternative fuel, in the form of ketone bodies. This shift occurs because the muscle and fat stores can no longer provide substrates from which to create new glucose as fuel. Ketone bodies, in the form of either acetoacetate or 3-hydroxybutyrate, are generated as fuel in the hepatocytes by beta oxidation of fatty acids, in the process of ketogenesis. Ketogenesis is also promoted by catabolic hormones such as glucagon - the hormone which dominates in starvation. Tissue adaptation from use of glucose as fuel to use of ketone body as fuel can be slow, particularly in the brain. Ketogenesis itself, like gluconeogenesis, involves a combination of catabolism and anabolism, destruction and creation, death-in-life.[14]

Starvation is also a good spiritual metaphor: to be hungry is to be in need, and dependent on God. When hungry, human beings know their place in the scheme of things. Hence the rebellion of the people of Israel against Moses in the desert journey of the Exodus. Hence the first temptation rebutted by Jesus during his desert fast. Hence the discipline of fasting in Lent, and at other-times, as advocated by Catholic spiritual practise over the centuries: evoking prayer, reflection, and meditation as inner resources for the regeneration of the life lived before God. [15, 16, 17]

Indeed, fasting is a practise which links the metaphor to the reality of starvation, such that the threat of death is discovered to be the way to life, such that dying-to-self is equated with living-to-God. The whole spiritual journey undertaken by Christians is understood in terms of hunger for God, and in terms of God feeding that hunger. That journey within the Catholic tradition is punctuated by sacraments which express the equation between dying-to-self and living-to-Christ, notably the sacraments of Penance and Eucharist. In these sacraments the double themes of sin/salvation, starvation/feeding, destruction/creation, death/life are exposed and explored.

By contrast, feeding separated from God's providence is a metaphor for spiritual Promethean hubris and arrogance, the desire to have power, and the desire to be a god. Hence the primordial sin of Adam and Eve in the Garden of Eden.[18] Hence the identification of Gluttony as one of the seven Deadly Sins.[19]

Gluconeogenesis and ketogenesis in response to starvation remarkably model the processes of the spiritual journey itself, as expressed in the discipline of Lent and the sacraments of Penance and the Eucharist.

**Dying to Live: Cells**

Second, death-in-life is demonstrated by programmed cell death, or apoptosis, which was

first characterised by the pathologist Andrew Wyllie. In essence, apoptosis means the selective removal of specific cells without disruption to the cell population from which they come.

In normal embryogenesis and organogenesis programmed cell death is essential for the involution of developmentally important but subsequently redundant structures, for example the Mullerian and Wolffian ducts. Programmed cell death is also important in the development of hollow organs, such as the heart, and for the removal of surplus cells such as the cell deletion reported during neurogenesis.

As the thymus develops, T-lymphocyte progenitors migrate into the cortex of the gland and become cortical thymocytes. However, 80-95% of these are eliminated by apoptosis employing endonuclease attack on DNA, followed by phagocytosis by proximate thymocytes. Only a minority of cortical thymocytes survive to become mature T-lymphocytes in the blood. Exposure to self-antigens during development is thought to provoke this wholesale deletion of thymocytes so that self-reactive cells are eliminated.

In the functioning endocrine system, absence of stimulating hormone leads to programmed glandular cell deletion, for example in prostate, breast, and adrenal cortex. Also, in the functioning immune system the removal of cytokine stimulation at the end of an immunological reaction leads to apoptosis of B-lymphocytes and T-lymphocytes.

Epithelial cell turnover is regulated by apoptosis in a variety of tissues, such as breast and endometrium. Also, the termination of the inflammatory response is fundamentally linked to the programmed cell death of extravascular neutrophil polymorphs.

Endonuclease attack on DNA seems to be the primary mechanism of apoptosis, and this attack is linked to calcium influx, in turn related to the synthesis of cell membrane pore proteins, in turn triggered by receptor activation caused by toxins and glucocorticoids. However, the mechanism is also dependent on the operation of three genes: ced 3 and ced 4 induce apoptosis, and ced 9 inhibits apoptosis. The inducer genes activate members of the ICE family of proteases which cleave critical proteins and activate a proteolytic cascade, leading to endonuclease attack itself, and the dismantling of cytoskeletal proteins.

The tumour suppressor gene p53 is also able to induce programmed cell death in response to DNA damage caused by radiation or chemical carcinogens, and many tumours show evidence of apoptosis. In AIDS infected patients, apoptosis is triggered, with selective attack on memory (CD4) T lymphocytes. By contrast, many viruses code for proteins which inhibit apoptosis.[20, 21]

Without programmed cell death development of body systems and organs would be disordered, cell turnover would be uncoordinated, tumour development would be more likely, and cellular responses to injury and infection would not be switched off. Apoptosis is a major mechanism for survival. Death of specific cells leads to life for the whole organism.

Once again, biological mechanisms and organisation provide metaphors for theological concepts. The Scapegoat theology of sacrifice and atonement was a device to renew the life of the whole community before God, by means of driving the guilt-carrying goat out of the

community into the wilderness and over a cliff.[22] Essentially, this is a "one-dies-for-all" theology of sacrifice, and is clearly a substitutionary prefigurement of the sacrifice of Christ on the Cross.[23, 24]

From a resurrection perspective, the death of Christ on the Cross is both a real death and the gateway to a new life. This association of destruction with creation (or re-creation) is symbolically re-enacted in the sacrament of Baptism, in which membership of the Body of Christ is related to drowning in the waters of baptism and rising out of those waters to the new life in Christ.[25]

Arthur Peacocke has said: "*God is in all the creative processes of his creation...*"[26] If we apply this statement to programmed cell death and to the death of Christ on the Cross, then we are forced to acknowledge that God must also be present in destructive processes which are themselves necessary for acts of creation and preservation. We must distinguish the negative connotation of death as loss, from the positive and adaptive understanding of death as necessity.

Programmed cell death implies adaptive purpose in nature, and design of the creator God. In his book, *Plan and Purpose in Nature*, George Williams claims: "*There is no evidence that God has any engineering expertise... organisms show the expected stupid mistakes, the dysfunctional design features, that arise when understanding and planning are entirely absent.*"[27] The death of Christ on the Cross was the climax of his life characterised by kenosis, or self-emptying, implying that self-restriction and self-emptying is also characteristic of God. This understanding leads Moltmann to a conclusion which gives answer to Williams' objection in these terms: "*God acts in the history of nature and human beings through his patient and silent presence, through which he gives those he has created space to unfold and time to develop.*"[28] Adaptive openness to the future, and its expanding horizons of possibility, are the characteristics of creation in these circumstances: for given the kenotic patience of the creator God, and the availability of a long timescale, interplay between death and life, between design and error, between certainty and risk, become normative.

**Dying to Live: Tissues**

Third, at the level of body tissues, the biological process of wound-healing also can be understood as death-in-life. In this context, a healthy tissue must be understood in terms of a functional and structural interplay between specialised cell types and supportive connective tissue matrix, including vascular basement membrane. Therefore, tissue destruction and death can relate to either or both of these elements: cells and matrix.

A typical wound causes the formation of a stabilising fibronectin-rich and fibrin-rich blood clot, due to vascular rupture. Within 1-2 days of injury, macrophages migrate to the site. These phagocytic cells demolish clot and tissue debris and remove inflammatory exudate, including neutrophils. These cells also are chemotactic for fibroblasts, which in turn migrate to the site, and then manufacture new matrix proteins to replace what has been demolished

and to improve the tensile strength of the connective tissue.
By means of chemical signalling, macrophages further cause the ingrowth of new blood vessels as endothelial cell capillary buds, which mature to revascularise the tissue. Collagen secretion by fibroblasts, combined with neovascularisation, leads to the formation of stabilising granulation tissue. However, macrophages and fibroblasts employ the destructive enzyme collagenase to remove the collagen III matrix first laid down, followed by deposition of new matrix collagen I by fibroblasts, as the healing process proceeds. In this way, macrophages and fibroblasts cooperate to remodel and strengthen the healing wound, acting alternatively as agents of destruction and creation.[29]

Macrophages also stimulate the ingrowth and proliferation of new epidermal cells which will recover the wound, by means of secreting growth factors, including EGF and TGFα and TGFβ. Significantly, if animals are depleted of macrophages they demonstrate very slow wound healing. In the macrophage we are confronted with an agent of cell and matrix destruction which is also an agent of cell and matrix re-creation: death-in-life, or even death-for-life.

Wound healing is a process, and therefore a journey; a movement from injury and wound to wholeness and health. It can therefore model the spiritual pilgrimage of faith in a number of respects.

Firstly, a link can be made between the wounding and the healing, which is not simply cause and effect, but rather the recognition that the same agent might be responsible for both. In biological wound healing, the macrophage is centrally involved in tissue demolition and also in tissue reconstruction. In the biblical tradition, spiritual wounding and spiritual healing are both ascribed to God. God is understood to strike us and heal us, to wound us and to bind us up.[30]

In response to apostasy by the Israelites in the desert, God tormented the people with poisonous snakes. In response to their consequent misery God provided a solution to heal them if they were bitten: Moses was told to make a bronze snake and set it on a pole for all those afflicted to see it. In this way, the snake was transformed from agent of wounding to agent of healing: and God was also understood to be the author of both wounding and healing.[31]

The wound of humanity is the great fracture of sin, and healing of the wound is prescribed in the Johannine tradition according to the imagery just outlined. Jesus on the Cross is none other than the snake on the pole, that all might behold, if aware of the wound of their sin, and be healed.[32]

Despite sharing the same imagery, these texts represent two very different understandings of sickness. In both, it is God who heals. In the former, it is God who wounds; whereas in the latter we wound ourselves by our participation in sin.

The spiritual journey, like wandering in the desert, is beset with risks and challenges; but nevertheless its destination takes us beyond where we are - and its destination is wholeness, fulfilment, completion. Creation places us in the world, as Heidegger's notion of Dasein suggests, but re-creation completes us. Yet re-creation is properly understood as

wholemaking or healing, and so cannot occur without wounding and suffering. Destruction then is a prelude to re-creation, and death a prelude to new life. Hence the usefulness of the biological image of the macrophage, and the biblical image of the snake, as we consider wound healing.

Secondly, in biological wound healing one tissue is replaced by another stronger tissue. The notion of new flesh is rooted in a Hebrew word (’[a]ruka) for health or wholeness; and is applied specifically to the healing of a wound, with the implication that the replacement new flesh is better than the old flesh. Biologically, replacement of collagen III by collagen I is an added refinement of this thought, and reinforces the point that healing should not just take us back to where we were, but rather beyond where we were.

Thirdly, the spiritual pilgrimage of faith consists not just of challenges and risks, but also of “letting go” in a variety of ways. This succession of “letting go” experiences comprise participation in death, while the pilgrimage of wholemaking itself leads to new life. The biological process of wound healing represents a vector towards wholeness and life, punctuated by coordinated organised cell death and connective tissue matrix destruction.

## CONCLUSION

This paper contends that biological models of dying-to-live can provide a fruitful positive corrective to the traditional Christian attitude to death, and a useful perspective on the Christian spiritual journey of growth in holiness, including the role of the sacraments of the Church.

The clearer definition of what is meant by the notion “dying-to-live” or “death-towards-life” sharply contrasts with a very different notion: death-towards-anihilation. Any theology of the Holocaust must come to terms with this other, very different, kind of death - a death not freely chosen, without meaning or purpose, except in the redemptive power and action of God.

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