

Life Ascending

The Ten Great Inventions of Evolution

Chapter 10: Death

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About

Dr Nick Lane is a British biochemist and writer. He was awarded the first Provost's Venture Research Prize in the Department of Genetics, Evolution and Environment at **University College London**, where he is now a Reader in Evolutionary Biochemistry. Dr Lane's research deals with evolutionary biochemistry and bioenergetics, focusing on the origin of life and the evolution of complex cells. Dr Lane was a founding member of the UCL Consortium for Mitochondrial Research, and is leading the UCL Research Frontiers Origins of Life programme. He was awarded the 2011 BMC Research Award for Genetics, Genomics, Bioinformatics and Evolution, and the 2015 Biochemical Society Award for his sustained and diverse contribution to the molecular life sciences and the public understanding of science.



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It's said that money can't buy happiness. But Croesus, King of Lydia in ancient times, was rich as ... Croesus, and thought himself the happiest of men. Seeking avowal from the Athenian statesman Solon, then passing through his lands, Croesus was irritated to be told, 'Count no man happy until he be dead'; for who can predict what Fate holds in store? And it so happened that Croesus, acting on an archetypically ambiguous oracle from Delphi, was captured by Cyrus, the Great King of Persia, and bound to a pyre to be burned alive. Yet instead of berating the gods for his excruciating end, Croesus murmured the name 'Solon'. Mystified, Cyrus enquired what he had meant, and was told of Solon's counsel. Realising that he, too, was a puppet of fortune, Cyrus had Croesus cut down (others say that Apollo came to his aid with a thunderstorm) and appointed him as an adviser.

Dying well meant a great deal to the Greeks. Fate and death were played out by invisible hands, which intervened in the most involved ways to bring men to their knees. Greek theatre is full of tortuous devices, death preordained by the fates, prefigured in cryptic oracles. As in frenzied Bacchic rituals and the fables of metamorphosis, the Greeks seem to owe something of their fatalism to the natural world. And vice versa: from the perspective of Western culture, the elaborate deaths of animals sometimes seem to assume the shade of Greek theatre.

There 's more than an element of Greek tragedy, for example, about the mayflies, which live for months as larvae, before metamorphosing into adults lacking in mouthparts and digestive tract. Even the few species that live out their single orgiastic day are fated soon to starve. What about the Pacific salmon, which migrate hundreds of miles to the streams of their birth, wherein their hormonally charged frenzy is cut short by a

catastrophic demise and death within days? Or the Queen bee, who shows no sign of her age for sixteen years, until finally her supply of sperm runs dry, whereupon she is torn apart by her own daughters? Or the twelve-hour copulation frenzy of the Australian marsupial mouse, culminating in death by depression and exhaustion, which can be prevented by castration? Tragedy or comedy, this is certainly dramatic. These animals are as much the pawns of fate as Oedipus himself. Death is not only inevitable; it is controlled by the fates, programmed into the very fabric of life.

Of all these grotesque modes of death, perhaps the most tragic, and resonant to us today, befell the Trojan Tithonus, whose goddess lover asked Zeus to confer immortality on him, but forgot to mention eternal youth. Homer has it that 'loathsome old age pressed full upon him', leaving him babbling endlessly. And Tennyson pictures him looking down on the 'dim fields about the homes of happy men that have the power to die, and grassy barrows of the happier dead'.

There is a tension between these forms of death, between the urgent death programmed into the lives of some animals and the abandonment of old age that faces humanity alone, the lack of a programme, the unspeakable endless end of Tithonus. This is exactly what we are visiting upon ourselves today, as medicine marches on, prolonging our lifespan but not our health. For every year of life granted by the gods of modern medicine, but a few months are spent in good health, and the rest in terminal decline. Like Tithonus, finally we beg for the grave. Death may seem a cruel cosmic joke, but ageing is mirthless.

Yet there should be no need to unmask Tithonus in our twilight years. Certainly, the intractable laws of physics forbid eternal youth as firmly as perpetual motion, but evolution is surprisingly flexible and shows that longer life is usually coupled with longer youth, avoiding the misery of Tithonus. Examples abound of animals whose lives have been extended painlessly, which is to say, without diseases, to two, three, even four times their original length, when circumstances change. One spectacular example is the brook trout that were introduced into the cold nutrient-poor waters of a lake in the Sierra

Nevada in California. Their lifespan quadrupled from barely six years, to more than twenty-four, the only apparent 'cost' being a delay in sexual maturation. Similar findings have been reported among mammals such as opossums. When shielded from predation on islands for a few thousand years, for example, opossums more than double their normal lifespan, and age at half the rate. We humans, too, have doubled our maximal lifespan over the last few million years without any obvious penalty. From an evolutionary point of view, Tithonus ought to be a myth.

But mankind has sought eternal life for millennia and signally failed to find it. While advances in hygiene and medicine have prolonged our average lifespan, our maximum lifespan, at about 120 years, has remained stubbornly fixed, despite all our efforts. At the very dawn of recorded history, Gilgamesh, King of Uruk, sought everlasting life in the form of a fabled plant, which after an epic search slipped through his fingers like a myth. It's been the same ever since. The elixir of life, the holy grail, the ground horn of a unicorn, the philosophers' stone, yoghurt, melatonin, all have been purported to extend life; none has done so. Blatant charlatans rub shoulders with scholars to colour the history of rejuvenation research. The celebrated French biologist Charles Brown-Séquard injected himself with extracts from the testicles of dogs and guinea pigs, and reported improved vigour and mental powers to the Société de Biologie in Paris in 1889, even demonstrating the proud arc of his urine before the flabbergasted assembly. By the end of that year, some 12,000 physicians were administering Brown-Séquard's fluid. Surgeons around the world were soon implanting sliced testicles from goats, monkeys, even prisoners. Probably the most notorious American charlatan of all, John R. Brinkley, made a vast fortune from his goat-gland transplants, before dying a broken man, the victim of a thousand ungrateful lawsuits. It's doubtful whether mankind has added a single day to our allotted tenure on this earth, for all our overweening ingenuity.

So there is an odd gap between the flexibility of evolution – the ease with which lifespan seems to be moulded – and the blank intransigence that greets our efforts to today. How does evolution extend lifespan so easily? It's plain from our millennia of abject failure that until we understand the deeper reasons for death, we will never get anywhere. On the

face of it, death is a perplexing 'invention': natural selection normally acts at the level of individual organisms, and it's hard to see how my death will benefit me, or what Pacific salmon gain from falling to pieces, or black widow spiders from being cannibalised. But it is equally plain that death is far from accidental, and it certainly evolved for the benefit of individuals (or rather, their selfish genes, in Richard Dawkins's unforgettable phrase) soon after the dawn of life itself. If we want to better our end, to evade the woes of Tithonus, we'd better go back to the beginning...

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