Profile

Leonard Hayflick and the limits of ageing

Eponyms have long been a feature of medicine and science. The textbooks are dotted with eponymous syndromes and diseases, with laws and constants, all flattering the memory of their inventors or discoverers. But there is only one eponymous limit in biomedicine: the Hayflick Limit, the number of times (about 50) that normal human embryonic cells can divide before they succumb to senescence.

Leonard Hayflick, professor of anatomy at the University of California at San Francisco, advanced the concept 50 years ago. The Hayflick Limit, he contended, was both an explanation for the phenomenon of ageing and a demolition of the wishful view (of some) that the human lifespan need have no upper limit. But although he correctly identified the cell nucleus as the location of the responsible mechanism, it fell to others to discern the structures involved. It was biologists Nobel Prize winners Elizabeth Blackburn and Carol Greider who showed how the cell keeps a tally of the number of times it has divided during its progress towards the Hayflick Limit. The ends of chromosomes carry structures called telomeres. Every time a cell divides the telomeres become shorter, this loss being the basis of what Hayflick described not as a clock (the process is not dependent on measuring time) but as a counting device, a "replicometer".

Now 83 years old, Hayflick no longer has his own laboratory, but is still closely involved with ageing. He writes, lectures, does consultancy work, and, in a satisfying manifestation of natural justice, reckons that the ageing process is treating him well. "I think I'm pretty much ahead of the game for two reasons", he says. "First of all I've absolutely no chronic medical problems that I'm aware of. And, perhaps more important, my mother is about to celebrate her 105th birthday." The genes, if not the telomeres, are on his side.

Life expectancy in most developed countries is, and has for many years, been creeping upwards: some 25 years over the past century. Much of this is the consequence of success at dealing with our traditional killer, infectious diseases. But the rate of increase, Hayflick contends, will diminish as we approach what he believes to be our natural average lifespan of around 92 years. America's thriving anti-ageing movement annoys him greatly. "The invention of ways to increase human longevity is the world's second oldest profession, or maybe even the first. Individuals are going to the bank at this moment with enormous sums of money gained by persuading people that they've found either a way to extend your life or to make you immortal." To imagine that the current rate of life expectancy increase will continue indefinitely is as absurd as extrapolating the diminishing time taken to run a mile and concluding that it will sooner or later be done in one second. "Everything in the Universe changes or ages with time, and to think that you can reverse it is nonsense." When asked how he responds to the idea in principle of finding some way to postpone death indefinitely, he responds with dry humour that any such development would be expensive, and therefore available only to the rich and powerful. "I don't know how many rich and powerful friends you have, but some of the ones I have I certainly don't want to live another decade or two beyond normal."

Hayflick's career has not been without struggle. That he looks back with no regrets surely reflects that he emerged from his two major disputes so triumphantly. The first concerned the discovery that bears his name. Ageing research generated little interest in the USA when he first entered it. It had been dogma for 60 years that the eventual death of normal human cells in culture was not due to some inherent property, but caused by ignorance of the proper conditions under which to culture them. It took what Hayflick describes as "10 or 15 painful years" for the scientific community to accept what he'd discovered. "To torpedo a half century old belief is not easy even in science."

The other and potentially more damaging dispute was with the US Government. The conflict began in the early 1960s when Hayflick was working at the University of Pennsylvania's Wistar Institute. He developed a cell line dubbed WI-38. Because it was living material it couldn't then be patented, so the vaccine companies to which it was freely distributed (it had proved to be exceptionally good for growing viruses) were earning a commercial return while the institution and the individuals who had created it were not. Hayflick set up his own company to distribute WI-38 and to hold payments for packaging and shipping until ownership was settled. The National Institutes of Health (NIH), which had previously supported the distribution, then accused Hayflick of stealing government property. He in turn filed a lawsuit against the NIH. After 6 years the action was settled out of court on terms that allowed Hayflick to continue distributing WI-38. The subsequent passage of the 1980 Bayh-Dole Act specifically allowed researchers at universities to apply for patents on federally funded inventions.

"What I had done was embraced as policy by the US Government", says Hayflick, who seems to look back on the saga less in sorrow than in glee. "Had my ideas not prevailed there would be no biotechnology industry." It was, after all, mostly scientists who'd developed new techniques and materials while supported by public funds who went on to set up the small companies which created that industry. "I consider it one of my most important achievements." As a researcher, Hayflick has shaped form as well as content.

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