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How chromosomes are protected by telomeres and the enzyme telomerase

Like most scientific discoveries, the function of telomerase and telomeres was found not by accident but by the need to solve a mystery. Telomeres, which had been discovered in the 1930s, were suspected of having a protective role for the cell, but their exact functioning was then unknown. What was also unknown was how the chromosome length remained the same after the copying of DNA when the DNA polymerase should have been unable to copy the end of one of the two strands. In 2009, Elizabeth Blackburn, Jack Szostak, and Carol Greider worked the solution out.

Szostak had found a linear DNA molecule - called a minichromosome - which rapidly degraded when introduced into yeast cells. On the other hand, Blackburn had discovered a repeating sequence of nucleotides - CCCCAA - at the ends of the chromosomes of a unicellular organism called *Tetrahymena*. In a combined experiment, they coupled the CCCCAA sequence into the minichromosomes and put it back into yeast cells. This led them to observe that the degradation of the minichromosomes had halted.

The fact that this function could transcend species indicated that the telomere DNA sequence performed some fundamental mechanism for many cells. Greider discovered signs of enzymatic activity that could produce telomeres on Christmas Day, no less. The telomerase enzyme was found to have protein and an RNA component which contained the CCCCAA sequence. This particular sequence was later shown to extend the telomere DNA and enable copying of the entire chromosomal length.

Scientists' investigations into the role of telomeres were also a combined effort. Szostak showed the decaying life of cells with short telomeres in mutated yeast cells, while Blackburn showed the same for *Tetrahymena*. Greider's group eventually proved this to be the case with human cells as well.

Overall, these scientists provided causes of multiple inherited diseases and insights as to why DNA attracts protective proteins for its ends, why Cancer cells are so hard to defeat, and whether the function of telomeres could be utilised as a tool to increase the longevity of human life. The last of those is a tricky question to tackle, both scientifically and ethically, but knowing more about its mechanism could well be a step in the right direction.