5. Tripati, A.K. *et al.*, Evidence for glaciation in the Northern Hemisphere back to 44 Ma from ice-rafted debris in the Greenland Sea, *Earth and Planetary Science Letters* **265**:112–122, 2008.
6. Dansgaard, W., Clausen, H.B., Gundestrup, N., Hammer, C.U., Johnsen, S.F., Kristinsdottir, P.M. and Reeh, N., A new Greenland deep ice core, *Science* **218**:1273–1277, 1982.
7. Willerslev *et al.*, ref. 1, p. 113.
8. Oard, M.J., *The Frozen Record: Examining the Ice Core History of the Greenland and Antarctic Ice Sheets*, Institute for Creation Research, Dallas, TX, p. 10, 2005.
9. Oard, M.J., Astronomical troubles for the astronomical hypothesis of ice ages, *Journal of Creation* **21**(3):19–23, 2007.
10. Koerner, R.M. and Fisher, D.A., Ice-core evidence for widespread Arctic glacier retreat in the Last Interglacial and the early Holocene, *Annals of Glaciology* **35**:19–24, 2002.
11. Overpeck, J.T., Otto-Bliesner, B.L., Miller, G.H., Muhs, D.R., Alley, R.B. and Kiehl, J.T., Paleoclimatic evidence for future ice-sheet instability and rapid sea-level rise, *Science* **311**:1747–1750, 2006.
12. Otto-Bliesner, B.L., Marshall, S.J., Overpeck, J.T., Miller, G.H., Hu, A. and CAPE Interglacial Project members, Simulating Arctic climate warmth and icefield retreat in the Last Interglacial, *Science* **311**:1751–1753, 2006.
13. Curry, ref. 2, p. 37.
14. Oard, M.J., Global warming—examine the issue carefully, *Answers* **1**(2):24–26, 2006.
15. Oard, ref. 8, p. 47.
16. Klevberg, P. and Oard, M.J., Drifting interpretations of the Kennedy gravel, *Creation Research Society Quarterly* **41**(4):289–315, 2005.
17. Klevberg, P., Bandy, R. and Oard, M.J., Investigation of several alleged paleosols in the Northern Rocky Mountains—Part I: background and methods, *Creation Research Society Quarterly* **44**(1):4–25, 2007.
18. Klevberg, P., Bandy, R. and Oard, M.J., Investigation of several alleged paleosols in the Northern Rocky Mountains—Part II: additional data and analysis, *Creation Research Society Quarterly* **44**(2):94–106, 2007.
19. Anonymous, Oldest DNA ever recovered suggests earth was warmer, 5 July 2007, <www.physorg.com/news102864888.html>.
20. Oard, ref. 8, figure 1.1, p. 3.
21. Oard, ref. 8, figure 2.6, p. 23.
22. Vardiman, L., *Climates Before and After the Genesis Flood: Numerical Models and Their Implications*, Institute for Creation Research, Dallas, TX, p. 57, 2001.

Serial cell differentiation: intricate system of design

Shaun Doyle

Single celled organisms replicate as fully functional cells, and they maintain cellular integrity through a system of direct epigenetic inheritance,[1] or 'cell memory'. Some tissues in multicellular organisms proliferate in the same way. However, the majority of tissues in adult multicellular organisms don't.

Most tissues in mature multicellular organisms replicate via a method called *serial differentiation*.[2] Cells go through a series of differentiation stages as they duplicate, ending in a fully differentiated cell, which eventually dies and passes out of the system, or is recycled by apoptosis (programmed cell death). There are three different types of cells in this system: stem cells, a class called 'transient amplifying cells' (TACs) and fully differentiated cells.

Serial differentiation

Stem cells

The undifferentiated cells are the only ones in this differentiation process that are self-renewing, i.e. they produce daughter cells that are exactly like the mother cell. These cells have the capacity to divide and change into many different types of cells. They are also very important during embryonic development, where new cell types are constantly needed.[3] These stem cells are kept relatively few in number, and the cell lines proliferate through the differentiation process.

Transient amplifying cells

The daughters of stem cells do more than just self-renew; they differentiate into different kinds of cells. However, they don't change into fully differentiated cells immediately; they change into a class called 'transient amplifying cells' (TACs). While TACs divide; unlike stem cells, TACs do not self-renew. Rather, the daughter cells of TACs are one stage further along the differentiation process than the 'mother' cell. These cells amplify the number of cells that will eventually become fully differentiated from the original stem cell that they started from.

Fully differentiated cells

A particular stem cell goes through a number of cell division events and the differentiation process of the TAC stage to produce fully differentiated cells. These are the mature cells that carry out the different jobs of the tissues, such as blood cells (figure 1), reproductive cells and epithelial cells. These cells no longer divide or differentiate, and once they have served their purpose, they are 'deleted' from the system and their components are recycled.[4]

Designed for maintenance

This is a rather elaborate system to conjure up if you just want to maintain tissues! It is also metabolically expensive because not only do the mature cells require nutrients, but so do the stem cells and TACs. Therefore, you're feeding cells that don't actually do anything in the body except replicate. So why bother using so much energy?

As Pepper *et al.* point out, the aim of this process is to separate the self-renewing and active proliferating properties of cells into different groups.[2] This severely limits the number of duplications that any one cell line will undergo, which limits the possibility of mutational damage taking hold in a particular tissue.

This system actively works against natural selection of individual cells in favour of tissue integrity to suppress somatic evolution, which is the change that the body is subjected to due to mutation and selection within the body's cell population. Pepper *et al.* comment:

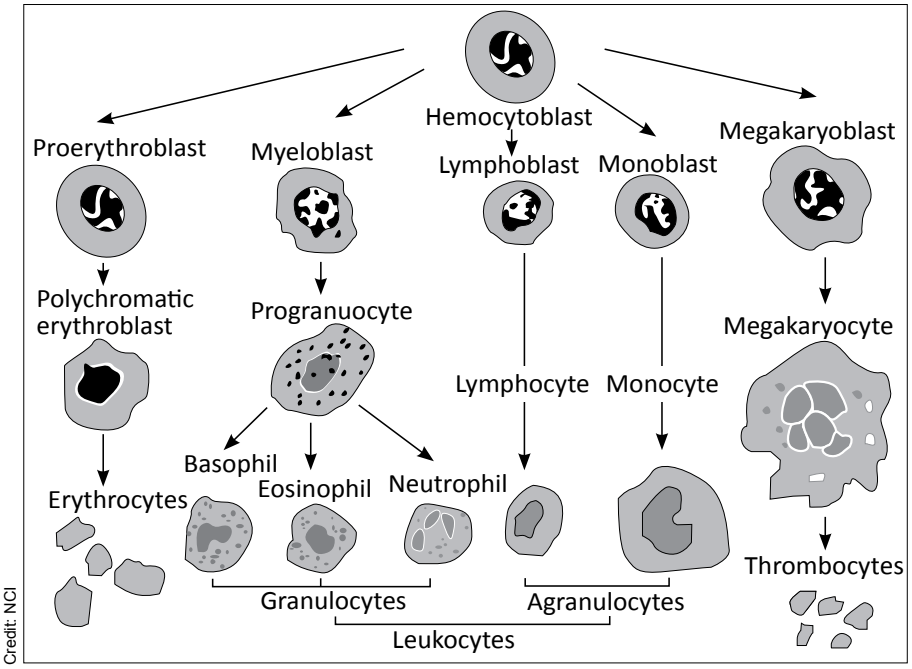

Figure 1. The process of hematopoiesis (the generation of blood cells) is an example of the serial cell differentiation process.

> 'We hypothesize that this is achieved in animals by compartmentalizing self-renewing tissues such that one cell population (stem cells) undergoes self-renewal, while another (TACs) undergoes active proliferation. If no cell population combines both these necessary elements of somatic evolution, somatic evolution is thereby suppressed.'

The stem cells are maintained as a small and quiescent population through slow self-renewal. The maintenance of the self-renewing population at low levels militates against selection of highly proliferative strains of stem cells.

The later stages of the differentiation process are focussed on proliferation, but they don't self-renew. Each duplication event moves the daughter cells along the next stage of differentiation, until the cells are shed after they have become fully differentiated.

While it would cost less energy to just have self-renewing mature cells, it would result in the quick death of the organism if something went wrong in comparison to serial differentiation. Less energy would be used up because the body would not have to support stem cells and TACs, but only fully differentiated cells. However, there is a much higher chance a mutation that increases the reproductive success of a particular cell would gain a hold in such a setup when compared to serial differentiation. Therefore, the benefit of longevity far outweighs the energy cost incurred for maintaining the system.

Evolution of multicellularity and serial differentiation

Pepper *et al.* also comment on the prospects of serial cellular differentiation aiding the transition from unicellular to multicellular life:

> 'It is believed that multicellular organisms could not have arisen or been evolutionarily stable without possessing mechanisms to suppress somatic selection among cells within organisms, which would otherwise disrupt organismal integrity. Here, we propose that one such mechanism is a specific pattern of ongoing cell differentiation commonly found in metazoans with cell turnover, which we call "serial dif-ferentiation."'[5]

They believe that this transition from unicellularity to multicellularity is controlled by epigenetic alterations:

> 'Thus, our results sup-port the suggestion… that epigenetic inheritance played a central role in the transition from unicellular to multicellular life by helping to control selection among the cells of the newly emergent multicellular individual.'[5]

However, both serial dif-ferentiation and the multicellular organism have to be assumed for this to work. At best it suggests how multicellularity persisted, but it does not suggest its origin.

There is a fundamental evolutionary conflict in a multicellular organism: cellular selection vs bodily integrity. Generally, natural selection at the cellular level will favour those cells that are better at reproductive competition and survival. However, if those cells are allowed to proliferate in an uncontrolled manner in a multicellular organism, it will inevitably disrupt the organism's bodily integrity, and harm or kill the organism.[6] This inevitably kills these 'fitter' cells too because they cause the host to die.

Cancer is a prime example. A cancer is essentially a mess of excessively proliferating cells within a multicellular organism. In an environment with limited resources (the organism), such cells will naturally out-compete normal cells because normal cells generally don't proliferate indefinitely. The cancer cells outstrip the normal cells for resources and take over the system. However, this leads to malfunction in the organism, and if left untreated, will inevitably kill the organism.

At the organismal level, selection will favour those traits that preserve bodily integrity, which seeks to control proliferation of cells beyond what is necessary. Pepper *et al.* confer:

> 'Multicellular organisms could not emerge as functional entities before

organism-level selection had led to the evolution of mechanisms to suppress cell-level selection.'[7]

However, this leads to a conundrum for the evolutionist: how do multicellular creatures evolve from single celled organisms when cellular selection is *diametrically opposed* to organism-level selection? A single cell seeks to proliferate more than its competitors; the multicellular organism seeks to control such proliferation to what is needed at a higher level of organisation. This can be seen in the process of apoptosis as well:

> 'Even today, apoptosis serves an essential role in terms of "cellular altruism". It helps to ensure that an organism's genetic integrity is not compromised, by removing some somatic cells that have sustained irreparable, genetic mutations. Crucially, apoptosis also helps to maintain a *species'* genetic integrity, by eliminating aberrant germ cells that would otherwise carry intact but faulty genes into the next generation.'[8]

The system of serial differentiation is designed to *enhance* bodily integrity, not reduce it. The system has to be in place before it can be selected for, yet organism-level selection cannot take over without measures such as serial differentiation in place. The very existence of this system argues against the evolution of multicellularity.

Conclusion

Serial differentiation is an essential system for the maintenance of mature multicelled organisms. It serves to separate the self-renewal and proliferative stages of cell division, which limits the effect mutations have on tissues. Evolution cannot explain the origin of the system, and neither can it explain the origin of multicellularity. These features of life clearly speak of purposeful, intelligent creation consistent with the Bible's account of creation.

References

1. Epigenetic inheritance refers to heritable characteristics in a cell that do not involve a change in the DNA sequence. For more information on the importance of epigenetic inheritance for life, see Alex Williams' three-part paper on biological inheritance: Inheritance of biological information—part I: the nature of inheritance and of information, *Journal of Creation* **19**(2):29–35, 2005, <www.creationontheweb.com/images/pdfs/tj/j19_2/j19_2_29-35.pdf>; Inheritance of biological information—part II: redefining the 'information challenge', *Journal of Creation* **19**(2):36–41, 2005, <www.creationontheweb.com/images/pdfs/tj/j19_2/j19_2_36-41.pdf>; Inheritance of biological information—part III: control of information transfer and change, *Journal of Creation* **19**(3):21–28, 2005, <www.creationontheweb.com/images/pdfs/tj/j19_3/j19_3_21-28.pdf>.
2. Pepper, J.W., Sprouffske, K. and Maley, C.C., Animal cell differentiation patterns suppress somatic evolution, *PLoS Comput. Biol.* **3**(12):2532–2545, 2007; <www.ploscompbiol.org/article/info:doi/10.1371/journal.pcbi.0030250>, accessed 14 Feb. 2008. Much of the following description of the process is based on this paper.
3. Sarfati, J., Stem cells and Genesis, *Journal of Creation* **15**(3):19–26, 2001; <creationontheweb.com/content/view/1845>.
4. Bell, P.B., Apoptosis: cell 'death' reveals creation, *Journal of Creation* **16**(1):90–102, 2002; <creationontheweb.com/content/view/5467>.
5. Pepper *et al.*, ref. 2, p. 2532.
6. Michod, R.E., Cooperation and conflict in the evolution of individuality. I. Multilevel selection of the organism, *The American Naturalist* **149**:607–645, 1997.
7. Pepper *et al.*, ref. 2, p. 2533.
8. Bell, ref. 4, p. 98.

The paradox of warm-climate vegetation in Antarctica

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The Northern Hemisphere Arctic lands are well known for their warm-climate fossil plants and animals from the Mesozoic and early Cenozoic of the uniformitarian geological column.[1–4] (Although I believe the geological column is a general Flood sequence with many exceptions,[5] I am using the orthodox scientific classification here for the sake of argument.) This situation commonly occurs at mid latitudes also.[6]

Sometimes logs are standing upright at these paleoflora sites or in nearby coal mines, even occurring at multiple levels, suggesting *in situ* growth to the uniformitarian scientist. Creationists describe such upright logs as polystrate fossils, and have reported features that are contrary to *in situ* growth.[7] Such warm climate plants and animals, including dinosaurs (assuming dinosaurs inhabited a warm climate), also occur in Antarctica.

More Antarctica climate conundrums

A recent article shows that the Antarctica flora during the Permian and Triassic was from a warm climate and so adding new conundrums to the climate paradox.[8] The geologists found upright logs interpreted to be *in situ* and one horizontal log 20 m long. Growth ring widths were 10 times those found in polar locations today. The rings contained mostly earlywood and only a small amount of latewood, suggesting a temperate climate with a rapid end to the growing season, considered to be caused by rapid reduction in light levels at such high latitude.

It has been known for a long time that fossil flora from the late Paleozoic to the Tertiary is from warmer climes