While human engineers solved the problem: 'How do you temporarily stop a motor once it gets going?' The Designer of the bacterial flagellum had anticipated that solution with a clutch.

but unpowered. This shuts down motility and facilitates biofilm formation.'[4]

This clutch mechanism is very efficient: it means that the germ needs to make only one protein to halt the powered filament motion, and this takes only 15 minutes. It also preserves the motor intact, so it could reactivate if necessary, rather than needing to be rebuilt from scratch. There also may be an advantage to building biofilms if the filaments were free to rotate in neutral rather than stopped rigidly.[4]

Design or evolution?

While human engineers solved the problem: 'How do you temporarily stop a motor once it gets going?' The Designer of the bacterial flagellum had anticipated that solution with a clutch.

Project leader Daniel Kearns made the obligatory vacuous homage to evolution:[7]

'We think it's pretty cool that evolving bacteria and human engineers arrived at a similar solution to the same problem: How do you temporarily stop a motor once it gets going?'[2]

It would make more sense to say: 'We think it's pretty cool that human engineers solved the problem: "How do you temporarily stop a motor once it gets going?" with a clutch, while the Designer of the bacterial flagellum had anticipated that solution.'

References

1. A good summary is by Howard Berg, a professor of molecular and cellular biology, and of physics, at Harvard University: Motile Behavior of Bacteria, Physics Today, 1999; <www.aip.org/pt/jan00/berg.htm>.
2. Microscopic clutch puts flagellum in neutral, Physorg.com, 19 June 2008; <www.physorg.com/news133108054.html>.
3. Blair, K.M., Turner, L., Winkelman, J.T., Berg, H.C. and Kearns, D.B., A molecular clutch disables flagella in the *Bacillus subtilis* biofilm, *Science* **320**(5883):1636–1638, 20 June 2008 | DOI: 10.1126/science.1157877.
4. Berry, R.M. and Armitage, J.P., How bacteria change gear: bacterial motility is arrested when a protein that acts as a clutch disables rotation of the flagellar motor, *Science* **320**(5883):1599–1600, 20 June 2008 (perspective on ref. 3) | DOI: 10.1126/science.1160444.
5. Biofilms have also helped understand one likely function of the appendix. See Bollinger, R.R., Barbas, A.S., Bush, E.L., Lin, S.S. and Parker, W., Biofilms in the large bowel suggest an apparent function of the human vermiform appendix, *J. Theor. Biol.* **249**(4):826–831, 2007; Wieland, C. and Doyle, S., More musings on our useless appendix, May 2008; <creationontheweb.com/appendix4>.
6. One of the discoveries that first put Albert Einstein on the map was the cause of Brownian motion, and proving the reality of atoms (Einstein, A., Über die von der molekularkinetischen Theorie der Wärme gefordete Bewegung von in ruhenden Flüssigkeiten suspendierten Teilchen (On the movement of small particles suspended in a stationary liquid demanded by the molecular-kinetic theory of heat), *Annalen der Physik* **322**(8):549–560, May 1905. The microscopic motion had been discovered by the botanist Robert Brown in 1827.
7. For another example of this language, see Sarfati, J., A coat of many colours, *Creation* **26**(4):28–33, 2004; <creationontheweb.com/chameleon>.

Another attempt to calibrate Ar–Ar dating methods

Barry Tapp

An international team of scientists have attempted to define a better calibration of the geologic timescale by comparing radioisotopic and astronomical dating of tephras in marine deposits from Morocco.[1] Using $^{40}Ar/^{39}Ar$ age definition of these tephras the authors seek to recalibrate the age of the Fish Creek sanidine which is the most widely used standard in argon-argon dating. They claim to reduce the uncertainty in argon-argon dating from about 2.5% to 0.25%.

The potassium–argon (K–Ar) and argon–argon (Ar–Ar) methods are widely used for radiometric dating and have become crucial in calibrating the geologic timescale. The idea is that since ^{40}Ar is inert and does not combine chemically with any other element it is assumed that any initial quantities of ^{40}Ar contained within the magma (molten rock) will easily escape before the magma crystalizes. This allows geochronologists to make plausible assumptions about the initial concentration of the ^{40}Ar daughter isotope, without which it is impossible to calculate an age. In other words, they assume the initial concentration of ^{40}Ar is zero.

It is impossible to know whether this assumption is correct. Any daughter product present at the time of formation in a sample is effectively a contaminant and distorts the resulting age determination. Any argon that did not escape but remained trapped within the rock when it solidified is called 'excess argon' but it is impossible to distinguish excess argon from radiogenic argon, since they are both the same isotope. The only way of checking is to compare the calculated age with the true age of the rock. If the calculated age is higher than the true age it is concluded that the sample contained excess argon. But how do scientists know the true age?

The other problem is whether the rock has remained 'closed' since it solidified, preventing isotopes from entering and leaving. Although closed systems do not exist in nature it is assumed that some rocks and minerals satisfy the requirements of a 'closed' system sufficiently to be deemed useful for nuclear age determination. The problem then devolves to one of judicious sampling procedure.

However Andrew Snelling[2–4] has shown that there are numerous examples wherein excess ^{40}Ar has been shown to be present in both geologically 'recent' and 'old' volcanic rocks. Therefore excess argon can be trapped in minerals within lava flows, invalidating the assumption of zero initial Ar, and rendering these age determinations quite spurious.

The argon-argon method of dating is essentially the same as potassium-argon method, but uses a different technique to measure the potassium isotope concentration. This is achieved by exposing the rock or mineral samples to neutron bombardment which transforms some ^{39}K into ^{39}Ar atoms. The number of new ^{39}Ar atoms formed is assumed to be proportional to the ^{39}K content of the original sample. The apparent constancy of the $^{40}K/^{39}K$ ratio means that the number of ^{39}Ar atoms formed is proportional to the number of ^{40}K atoms in the sample. This transformation makes it easy to measure the fraction (ratio) of $^{40}Ar/^{39}Ar$ in a mass spectrometer and the result is used to calculate the age of the sample since it is proportional to the daughter/parent radioisotope. That is $^{40}Ar/^{39}Ar = \text{Constant} \times {}^{40}Ar/^{39}K$ where the constant is determined by calibrating against a standard sample, such as the Fish Creek sanidine.[5]

One real advantage of this technique is that the argon isotope ratios can be measured with great precision. Another is that only a small microgram sample is required for analysis. It is also claimed that the technique can determine if 'excess', or 'parentless', ^{40}Ar has entered the sample from outside the sample system by checking whether the repeated results are consistent or inconsistent with each other, but this claim has been shown to be incorrect.[6] Furthermore, calibration is required to convert the argon-argon ratios to potassium-argon ratios before calculating an age.

The means of calibration is by tying the argon-argon ratios to what is termed astronomical time control. However, as the paper by Kuiper *et al*. states, previous attempts at calibration have been hampered by uncertainties in the 'location of magnetostratigraphic boundaries and their correlation to the astronomical polarity time scale, assumptions regarding constancy of sedimentation rates … or uncertainties in astronomical time control.'[7] The authors argue that by applying single crystal argon-argon dating techniques to sanidine phenocrysts from silicic tephra layers found within a marine succession from the Messinian Melilla Basin in Morocco, all of these problems are circumvented.

Photo iStockphoto

Calibrating broken clocks is an impossible task.

This sounds good in theory, but a closer reading of the paper shows that this is not true. In the following paragraphs the authors list a number of problems and assumptions encountered in their technique. Although the results look very impressive, with respect to the astronomical ages of the radioisotopically dated tephra horizons, they conclude that, 'no exact error can be calculated, but taking these uncertainties [these are listed in the text] into account and provided that the tuning and correlation itself is correct, we estimate that the uncertainty in the astronomical ages for the volcanic layers is about 10 ky.'[7]

This is an incredibly precise factor and the authors feel confident that their method allows definition of the K/T boundary to a date of 65.957 ± 0.040 Ma. This particular method may give what were considered appropriate results in this case but it does not guarantee its usefulness in other geologic environments: every date determination is checked against an expectation of what it should be. Any variation considered to be too large is necessarily explained away. Given the assumptions listed in their paper and the indirect methods of defining the calibration factor this is highly questionable. It would be interesting to determine what the overall reliability of their results would be if all the errors were taken into account and calculated.

References

1. Kuiper, K. *et al.*, Synchronising rock clocks of earth history, *Science* **320**:500–504, 25 April 2008.
2. Snelling, A.A., Andesite flows at Mt Ngauruhoe, New Zealand, and the implications for potassium-argon 'dating', in: Walsh, R.E., *Proceedings of the Fourth International Conference on Creationism*, Creation Science Fellowship, Pittsburgh, PA, p. 503–525, 1998; <www.icr.org/index.php?module=research&action=index&page=researchp_as_r0119>.
3. Snelling, A.A., Conflicting 'ages' of Tertiary basalt and contained fossilised wood, Crinum, Central Queensland, Australia, *Journal of Creation* (*CENTJ*) **14**(2):99–122, 2000; <creationontheweb.com/crinum>.
4. Snelling, A.A., Radioactive 'dating' failure, *Creation* **22**(1):18–21, 2000; <creationontheweb.com/radiodating>.
5. DeYoung, D., *Thousands not Billions*, Master Books, Green Forest, AR, p. 41, 2005.
6. Walker, T., A Christian response to radiometric dating, 21 September 2007, <creationontheweb.com/wiens>.
7. Kuiper *et al.*, ref. 1, p. 500.