EDITORS' CHOICE

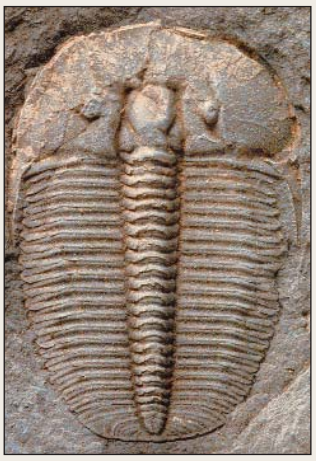
edited by Stella Hurtley

ECOLOGY/EVOLUTION

Fossil Trilobite Development

Body segmentation in arthropods has been an abiding theme of developmental biology since the 19th century. In recent years, there has been a renaissance of studies of the evolution of these developmental patterns, in parallel with the increasing knowledge of the underlying genetics and cell biology.

Fusco *et al*. take advantage of the exceptional fossil record of one of the early segmented animals—the trilobite—to investigate developmental evolution. Mature individuals of the trilobite *Aulacopleura konincki*, from Silurian deposits in the Czech Republic, show variation in the number of thoracic segments. Abundant fossil material at all post-hatching developmental stages enabled a detailed analysis of growth and segmentation in this species, and an assessment of whether the number of segments was determined early or late in development. Morphometric analyses suggested that segment number was under tight control early in the developmental process, as is also the case in modern arthropods, such as centipedes. Thus, fossil material can be used successfully to compare developmental processes in extinct and existing organisms. — AMS



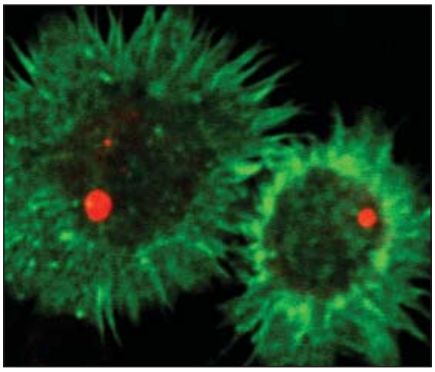
Fossil trilobite.

Am. Nat. **163**, 167 (2004).

CELL BIOLOGY

Of DALIS and DRiPs

Dendritic cells of the immune system respond to inflammatory signals by undergoing a process of maturation that equips them for antigen processing and presentation. In mature dendritic cells, polyubiquitinated proteins are sorted to intracellular aggregates that have been termed DALIs (for dentritic cell aggresome-like induced structures). DALIs only form when protein synthesis is ongoing; inhibition of protein synthesis leads to their disassembly. Lelouard *et al*. examined what processes are involved in targeting defective proteins and peptides to DALIs. In the presence of the peptide elongation inhibitor puromycin, incompletely synthesized proteins accumulate. These defective ribosomal products (or DRiPs) were observed to be stored rapidly in DALIs, where they were protected from degradation. Neither an intact microtubule network nor the actin microfilament network was required for this targeting. The DALIs were the sites at which DRiPs appeared to become ubiquitinated. DriPs also form in the absence of puromycin, and the production of these products from self and viral antigens is important in MHC class I restricted antigen presentation. It thus appears that dendritic cells are able to regulate the degradation of DRiPs by producing DALIs and this, in turn, is likely to be important in regulating antigen processing and presentation. — SMH



Mature dendritic cells with actin (green) and DALIs (red).

J. Cell Biol. **164**, 667 (2004).

MOLECULAR BIOLOGY

MicroRNA Monkey Wrench

Hundreds of microRNAs (miRNAs) have been discovered in the genomes of almost all eukaryotes studied. Indeed, the predicted fraction of miRNAs in the human genome is similar to that of transcription factors, yet the functions of only a handful of these miRNAs are known. Sequence-based bioinformatics analyses suggest that miRNAs are involved in many critical cellular and developmental functions. Understanding the role of miRNAs would be helped by the ability to eliminate their function genetically—a process complicated both by their small size and by the fact that multiple miRNAs have identical or very similar sequences, potentially requiring multiple knockouts.

Hutvágner *et al*. and Meister *et al*. have both developed an antisense-based method to efficiently and irreversibly inactivate specific miRNAs. The trick is to make an oligonucleotide complementary to the miRNA and then modify it with a 2′-*O*-methyl group. This renders the oligo resistant to degradation, yet allows it to rapidly and stably hybridize with its miRNA target. Using this method, specific miRNAs could be knocked out irreversibly and with high efficiency in vitro, in tissue culture cells, and in whole organisms. — GR

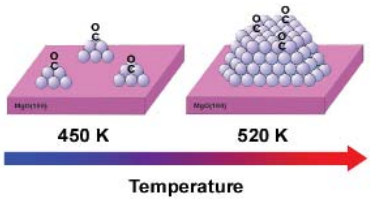
PLOS Biol. **2**, 10.1371/journal.pbio.0020114 (2004); *RNA* **10**, 544 (2004).

CHEMISTRY

Cooler Cluster Catalysis

Very small metal clusters with a size of tens of atoms can be synthesized with molecular beam sources in the gas phase. However, wet chemical methods are generally needed to create the much larger metal clusters containing thousands of atoms. Large metal clusters can be bound to metal oxide supports and used as heterogeneous catalysts.

Judai *et al*. have examined the reactivity of gas-phase Pd clusters (Pd_4, Pd_8, and Pd_{30}) that were soft-landed on an MgO oxide support. The Pd_4 clusters were unreactive in the classical auto-exhaust conversion reaction ($CO + NO \rightarrow CO_2 + {}^1/_2N_2$), but the larger clusters were active and showed maximal rates at 450 K for Pd_8 and 420 K for Pd_{30}. These temperatures are about 100 K less than those reported for supported Pd catalysts or metal surfaces. — PDS



Change in cluster size with temperature.

J. Am. Chem. Soc. 10.1021/ja039037k (2004).

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EARTH SCIENCE

Old and Crusty

Some of the oldest rocks on Earth are found in the Davenport Range of central Australia, having crystallized in the Pre-Cambrian (>560 million years ago) or the Cambrian (about 560 to 530 million years ago). Cratons are the first continental land masses to form, and the remnants of the first landmasses make up the stable and thick crustal cores of several modern continents. Some of the earliest evidence for life in the rock record comes from the Australian craton.

Australian Davenport Range showing Cambrian conglomerate exposure (foreground) and the flat ridge of the "Ashburton Surface" (background).

CREDIT: BELTON *ET AL.*, *EARTH PLANET. SCI. LETT.* **219**, 21 (2004)

Previous work has suggested that some of the outcrops in the outback have not been altered, making the landscape almost as old as the rocks. Belton *et al.* used apatite fission track thermochronology and Be-10 and Al-26 in situ cosmogenic radionuclide analyses to determine the rates of erosion. The rates vary from 0.4 to 4.0 m per million years to punctuated periods of erosion with rates as high as 17 m per million years. These rates suggest that the landscape has changed over 500 million years, experiencing multiple periods of burial and exhumation related to the northward migration of the Australian landmass and collisions with terrains in Asia. — LR

Earth Planet. Sci. Lett. **219**, 21 (2004).

MEDICINE

Take HAART

Substantial progress has been made in the treatment of HIV infection using highly active antiretroviral therapy (HAART). Nevertheless, a serious limitation of this form of treatment is its inability to eliminate latent infection, meaning that patients must remain on HAART indefinitely to maintain low levels of the virus. Multiple approaches aimed at depleting the latent HIV reservoir have not, so far, met with success.

Saavedra-Lozano *et al.* employed an immunotoxin (IT) to target memory CD45RO$^+$ CD4$^+$ T cells, which make up a dominant fraction of the latent HIV reservoir. In previous work, the authors demonstrated that CD45RO-IT depletes virally infected T cells in vitro, although it was not clear whether similar effects would be seen on T cells from latently infected patients with very low viremia. In the new study, a significant decline in CD4$^+$ T cell–associated virus was observed after ex vivo CD45RO-IT treatment of peripheral blood mononuclear cells from HAART patients whose viral titers were below levels that could be quantified. Encouragingly, the treatment had only marginal impact on CD8$^+$ T cell memory responses, suggesting that IT-based therapy might be effective at eliminating the latent HIV reservoir while preserving a significant fraction of remaining memory T cells. — SJS

Proc. Natl. Acad. Sci. U.S.A. **101**, 2494 (2004).

GEOLOGY

Cold Snaps in the Cretaceous

The Late Cretaceous, 80 to 65 million years ago, has typically been thought of as a time with a warm climate. Dinosaurs flourished all over Earth, including at sites near both poles, and it has been thought that atmospheric CO_2 levels were also high during the Cretaceous. Some recent studies, however, have provided evidence for the occurrence of glacial cycles at times during the Late Cretaceous.

Miller *et al.* now provide a detailed study of sea level changes from sediments recovered in drill cores on the Atlantic coastal plain off New Jersey, USA. The nature of the sediment (sand versus mud) provides information about ocean depth. By accounting for subsidence and compaction, and by using Sr isotopes for dating, an accurate relative sea level curve was produced. The results imply that sea level changed abruptly, by about 25 m, numerous times from about 95 to 65 million years ago. These changes may reflect the growth and demise of local ice sheets in Antarctica, supporting the notion that glacial cycles were ongoing during this period. — BH

Geol. Soc. Am. Bull. **116**, 368 (2004).