ORGANIC CHEMISTRY

Cockroach cruncher

Angew. Chem. Int. Ed. doi:10.1002/anie.200902192 (2009)

Powdered leaves from the Mexican cockroach plant, *Haplophyton cimicidum*, have been used to poison cockroaches and to repel fleas for hundreds of years. And attempts to synthesize one of the plant's active ingredients — the indole alkaloid (+)-haplophytine — have frustrated organic chemists ever since its complex molecular structure was solved in 1973.

Hidetoshi Tokuyama at Tohoku University in Sendai, Japan, and his colleagues now report the first total synthesis of (+)-haplophytine, creating 4.2 milligrams of the molecule. In a key step, the researchers performed an internal rearrangement to create the left-hand segment of the molecule. They then used a traditional Fischer indole synthesis to join that, through a central bond, to the previously synthesized right-hand segment.

IMMUNOLOGY

Themis in the thymus

Nature Immunol. doi:10.1038/ni.1768; doi:10.1038/ni.1766; doi:10.1038/ni.1769 (2009)

The maturation of pathogen-fighting T cells relies on a mysterious protein called Themis, three independent groups have found.

Themis is expressed exclusively in T cells, but its protein sequence — although highly conserved in vertebrates — provided few clues to its function. All three teams generated mouse mutants that lack the full-length Themis protein, and found that the usual process by which properly functioning T cells are selected to continue maturation in the thymus was impaired. The result: fewer T cells survived this selection, and the mice contained smaller numbers of mature T cells.

Paul Love of the National Institutes of Health in Bethesda, Maryland, and his colleagues found that this defect could be reversed by stimulating signalling through a protein complex called T-cell antigen receptor (TCR), which is crucial for the activation and development of T cells.

Meanwhile, a second group led by Nicholas Gascoigne of the Scripps Research Institute in La Jolla, California, demonstrated that signalling through the TCR mediated by two other key molecules — calcium and a protein called Erk — is reduced when Themis is lacking. And a team headed by Richard Cornall of the University of Oxford, UK, and Ronald Schwartz, also of the National Institutes of Health, found that the expression of several genes, including those involved in cell survival, was reduced in these mutants — possibly contributing to eventual T-cell death.

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DEVELOPMENTAL BIOLOGY

The turtle fold

Science **325,** 193–196 (2009)

The bodies of turtles and other chelonians are fundamentally different from those of all other animals. Their distinctive shells develop from the ribcage, which lies above, rather than below, the shoulder blades.

Shigeru Kuratani and his colleagues at the RIKEN Center for Developmental Biology in Kobe, Japan, compared the embryogenesis of the Chinese soft-shelled turtle (*Pelodiscus sinensis*, pictured below left) with that of other animals to understand how developmental changes may have resulted in the turtle's unusual form. The authors found that whereas the ribs of mice and chickens grow to encircle the body, those of turtles grow outwards and then stop, with the shoulder blades tucking under the edges of the ribs.

NEUROLOGY

New neurons show the way

Science **325,** 210–213 (2009)

Researchers have uncovered a function of new neurons that are generated in the brains of adult mice.

The role of adult neurogenesis in a brain region called the hippocampus has been difficult to pin down because the effects seem to be subtle and it is technically tricky to selectively disrupt neuronal development in adult animals. Fred Gage of the Salk Institute for Biological Studies in La Jolla, California, Timothy Bussey at the University of Cambridge, UK, and their colleagues designed challenging tasks that required mice to distinguish between very similar surroundings.

Using two techniques to knock down neurogenesis, the authors discovered that although the new neurons were not necessary for easy navigational tasks, they were important for more complex ones. Notably, for remembering very small differences in the spatial arrangement of their environment.

JOURNAL CLUB

Friedhelm von Blanckenburg
GFZ German Research Centre for Geosciences, Potsdam, Germany

A geochemist learns that mountain building does not accelerate rock weathering.

Mountain building has been deemed essential for stabilizing Earth's climate over the scale of millions of years. As tectonic forces push mountains into the sky, they provide fresh rock surface that is degraded by the physical effects of rain and temperature change, and by chemical weathering as carbon dioxide is dissolved in rain to form carbonic acid. Atmospheric CO_2 is thus consumed to convert rock into soil, which happens fastest where erosion rates are highest, exposing new rock to be weathered. Rivers then transport this carbon to the oceans where it is disposed of as carbonate sediment.

But many Earth scientists have questioned this story. Wouldn't periods of high tectonic activity, such as the rise of the Himalayas, provide enough rock to consume so much CO_2 that the planet would turn into an ice house?

Yet the consequences of mountain building are perhaps less profound than expected. The amount of weathering over time can be accurately measured on hill slopes using new geochemical methods that combine solute loss from soils with radioactive isotopes formed by cosmic rays to determine how long it takes for rocks to break down into soil. Two recent papers modelled the implications of this approach numerically. Surprisingly, the prediction is that weathering decreases rather than increases at erosion rates typical of high, active mountains (K. L. Ferrier and J. W. Kirchner *Earth Planet. Sci. Lett.* **272,** 591–599; 2008; E. J. Gabet and S. M. Mudd *Geology* **37,** 151–154; 2009). So hill-slope weathering in the Himalayas might do no more to withdraw CO_2 than any actively eroding, mid-altitude mountain range found worldwide.

Perhaps geochemists have been looking in the wrong place. Does the CO_2-consuming mineral decomposition thought to occur on high slopes actually happen on the floodplains below large, active mountains? We might need to take a closer look at these areas before we really understand the geological carbon cycle.

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