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## ECOLOGY

### Carnegie Blows Up Biodiversity

To assess the effects of anthropogenic changes on biodiversity, we need to know not only what exists but what existed, Dolan contends in an analysis of historic plankton samples collected on the final cruise of the ship *Carnegie* during 1928–1929. Built for oceanography, on its last global voyage it was equipped to systematically collect plankton. Plankton were obtained from 160 sampling stations. Three groups were chosen for identification and counting to represent distinct trophic levels: small copepod crustaceans, *Ceratium* dinoflagellate alga, and ciliate zooplankton called tintinnids. Reanalysis of these collections revealed that changes in species richness were correlated for the three groups, and more species were collected at the tropics than at high latitudes. Interestingly, of the several hundred species, most were rare and few were common. Although potentially a rich source of now-unfunded taxonomic expertise, historical data do have gaps and study design issues that cannot now be resolved. Sadly, the *Carnegie's* adventure came to an end when it, and its scientist, Captain Ault, were blown up while refueling in Samoa. — CA

*J. Plankton Res.* 33, 10.1093/plankt/fbr060 (2011).

## DEVELOPMENT

### Controlling Sex

Chromosomes are packaged into transcriptionally silent heterochromatin and transcriptionally active euchromatin. The highly conserved protein HP1a marks heterochromatin in *Drosophila*, and heterochromatin-rich telomeres are capped by a protein complex composed of HP1a and HP1/ORC-associated protein (HOAP). Because knockdown of HP1a is associated with loss of male viability, and the HP1a-HOAP complex shows similarity to the mammalian sex-determining region of the Y chromosome (SRY), Li *et al.* sought to investigate the role of this complex in regulating sex determination in *Drosophila*. The authors carried out gene expression analysis in HOAP-deficient flies and found that the majority of down-regulated genes were those associated with the testis. Further analyses showed that this was due to repressive activity by HOAP and both repressive and activating functions of HP1a that affected the function of the establishment promoter of *Sex-lethal*, the master regulator of sex determination. Flies mutant in HP1a or HOAP exhibited defects in sex determination. Thus, proteins typically associated with heterochromatin are critical for regulating the changes in gene expression required for sex determination in flies. — LMZ

*PLoS Genet.* 7, e1002122 (2011).

## CLIMATE SCIENCE

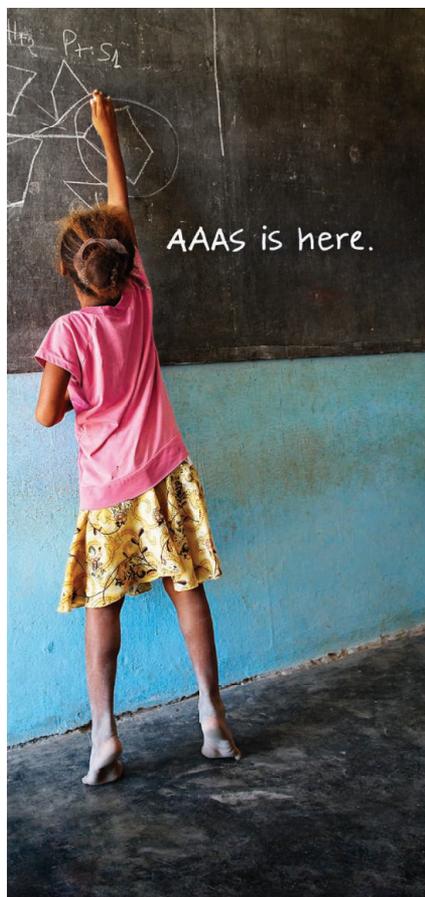
### In Synch with the Weather

Cooling climates in Africa over the past 10 million years have led to substantial environmental changes that might have influenced human evolution. Demonstrating a specific relation, however, has been difficult because the human fossil record is sparse, and uncertainties in dating of both these fossils and climate records make correlation at the necessary resolution (within 100,000 years) problematic. To help tackle some of these issues, Joordens *et al.* examined strontium isotopes from fish fossils in sediments from Lake Turkana that also contain human fossils, focusing on an interval around 2 million years ago. Rivers feeding the lake drain rocks with different Sr isotope compositions, and thus the lake Sr chemistry varied during monsoon wet and dry periods. The record, which extends over about 150,000 years, implies that this variation primarily reflects the precession of Earth's orbit, which varies over about 21,000 years. The sediments were deposited during a well-known magnetic field reversal, allowing an accurate time-climate sequence to be constructed. The authors were able to place 12 hominid fossils into the finely calibrated sequence. Although the age span is too brief to establish a larger relation between climate change and human evolution, the approach could lead to longer records here and elsewhere. — BH

*Earth Planet. Sci. Lett.* 307, 1 (2011).

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## Rwanda

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### STRUCTURAL BIOLOGY

## Chromatin Regulation Unraveled

Histones are proteins that act to package DNA into chromatin. The methylation of lysine 4 on histone H3 is correlated with active gene expression in eukaryotes. In mammals, H3K4 is methylated by the MLL family of histone methyl transferases (HMTs). The catalytic subunits all share a SET domain, but full activity requires the presence of other complex components. One core component is Ash2L, which comprises a zinc-finger motif and a carboxy-terminal SP1a and ryanodine receptor (SPRY) domain. Chen *et al.* and Sarvan *et al.* have determined the structure of the N-terminal domain of human Ash2L. Both found that besides a zinc finger, the domain includes a winged-helix motif, a DNA binding motif that is often involved in transcription regulation. The zinc-finger domain was previously proposed to bind histone tails; however, in the context of the structure, it lacks features required for such binding. Sarvan *et al.* show that the Ash2L winged-helix domain is required for binding to the  $\beta$ -globin locus control region, H3K4 methylation, and maximal expression of the  $\beta$ -globin gene, whereas Chen *et al.* show that it binds preferentially to an active chromatin domain in a Homeobox gene locus and suggest that it may play a role in chromosome demarcation. — VV

*EMBO Rep.* **12**, 10.1038/embor.2011.101 (2011);  
*Nat. Struct. Mol. Biol.* **18**, 10.1038/nsmb.2093 (2011).

### DEVELOPMENT

## Feedback Forms Frogs

Signaling by gradients of the morphogen BMP (bone morphogenetic protein) controls the contributions of individual cells to the developing embryo. Genes encoding components of the BMP signaling pathway are expressed together in groups that include both components that favor BMP signaling and also feedback inhibitors of the pathway. Paulsen *et al.* used a combination of experiments and mathematical modeling to explore what advantage this organization of the BMP signaling module might confer. Human embryonic kidney cells responded to a range of BMP concentrations that varied almost 100-fold. But when a feedback inhibitor was removed, the dynamic range of response was reduced by a factor of 10. Another important role of the feedback inhibition was to reduce cell-to-cell variation in the response to BMP. Indeed, in *Xenopus* tadpoles, loss of feedback inhibitors led to a several-fold increase in variability in tail length during development. Thus, this developmental regulatory system is optimized to promote a robust, relatively constant phenotype in the face

of genetic, environmental, and stochastic variation or noise. — LBR

*Proc. Natl. Acad. Sci. U.S.A.* **108**, 10202 (2011).

### PHYSICS

## The Pulling Power of Pairs

The functionality and characteristics of many semiconductor devices depend crucially on the movement of electron-hole pairs in response to an applied electric field. In such ambipolar devices, it is typically the heavier holes that dominate the transport properties. As such, the packets of charged pairs move in the direction of the holes. Some experiments, however, exhibit behavior opposite to that expected motion and have been interpreted in terms of a correlation field, or friction, between the electrons and holes. Yang *et al.* use a transient grating spectroscopy technique to probe the electron and hole pair packets as they drift and diffuse in a single quantum-well structure. An electron-hole density grating is imprinted in the quantum well by two interfering laser beams. Monitoring the diffraction of a probe beam through the grating as it evolves and decays provides a detailed picture of the electrons' and holes' dynamics. With a model, the authors are then able to determine the degree of friction between them. The technique should provide a route to better understanding the operation of such ambipolar devices and, from the polarization dependence, the operation of spintronic devices based on the spin properties of the carriers. — ISO

*Phys. Rev. Lett.* **106**, 247401 (2011).

### CHEMISTRY

## Solvated Past the Finish Line

As concerns mount about the adverse impact of atmospheric CO<sub>2</sub> on climate, there is increasing interest in diverting some of the greenhouse gas toward use as a feedstock for the industrial preparation of commodity chemicals. One promising reaction in this vein is hydrogenation to formic acid (HCOOH). This process is enthalpically favorable, but the entropic penalty for turning two gases into one liquid molecule pushes the overall equilibrium back toward the reactant side. Amines can deliver an enthalpic kick by deprotonating the acid. Schaub and Paciello found, however, that when trihexylamine is used as a base for ease of product isolation, the kick isn't quite vigorous enough. Adding a diol solvent inches the reaction over the line to thermodynamic favorability, presumably by stabilizing the ionic products through hydrogen bonding. — JSY

*Angew. Chem. Int. Ed.* **50**, 10.1002/anie.201101292 (2011).