## In Search of Unparticles

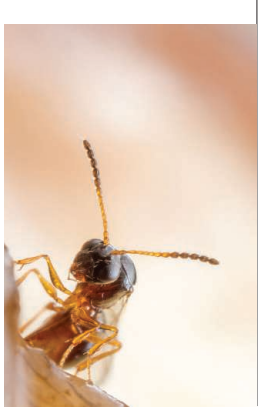
The standard model of particle physics, which describes the basic building blocks of the universe and the interactions among them, is incomplete. Numerous theoretical extensions have been proposed, some of which predict long-range, spin-spin interactions. To test whether such interactions exist, a laboratory spin source is normally used. **Hunter *et al.*** (p. 928) used Earth as a polarized spin source and looked for these interactions by changing the geographical position and the orientation of the measurement apparatus. The polarized spins mainly come from the electrons in iron-containing minerals of Earth's mantle, which align in Earth's magnetic field. The large numbers of such polarized electrons allowed the extraction of upper bounds on some of the exotic spin-spin interactions far lower than those obtained in the laboratory.

## Cost-Benefit of ART

In the battle to control HIV, mass antiretroviral treatment (ART) costs $500 to $900 per person per year. **Bor *et al.*** (p. 961) calculated the impact of intensifying ART on the life expectancy of people living in rural KwaZulu Natal. The dates of death were collected from a population of about 100,000 people during 2000–2011: Four years before and 8 years after the scaling up of ART. Life expectancy of adults increased by more than 11 years after ART was expanded, and the economic value of the lifetimes gained were calculated to far exceed the cost of treatment. **Tanser *et al.*** (p. 966) followed nearly 17,000 HIV-uninfected individuals in KwaZulu-Natal over an 8-year period. Holding other HIV risk factors constant, individual HIV acquisition risk declined significantly with increasing ART coverage of HIV-infected people.

## Mother Knows Best

Fruit flies feed on decomposing fruit, a food source rich in alcohol, and thus have evolved a high alcohol tolerance not shared by many other species. High levels of ingested alcohol protect fly larvae against parasitic wasp larvae. **Kacsoh *et al.*** (p. 947) show that this therapeutic use of alcohol to combat a parasite has an intergenerational component. When fly mothers were permitted to see parasitic wasps, they preferentially laid their eggs on substrates containing high alcohol levels as a way to medicate their offspring against potential infection.



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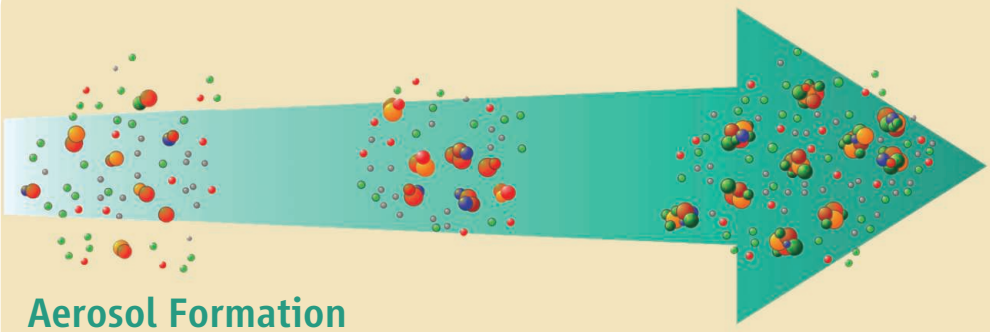


## Aerosol Formation

**Most atmospheric aerosol particles result from a growth process that begins with atmospheric molecules and clusters, progressing to larger and larger sizes as they acquire other molecules, clusters, and particles. The initial steps of this process involve very small entities—with diameters of less than 2 nanometers—which have been difficult to observe. Kulmala *et al.* (p. 943; see the Perspective by Andreae) developed a sensitive observational protocol that allows these tiny seeds to be detected and counted, and they mapped out the process of aerosol formation in detail.**

## Water Flowing Underground

In addition to serving as an out-of-sight, yet much-needed water source, groundwater influences ecosystems on land—especially when the groundwater depth is shallow. **Fan *et al.*** (p. 940) used government archives and published studies to construct a global map of groundwater depth based on over 1,000,000 direct well measurements. A groundwater model was then used to construct a continuous global map of groundwater depth. The findings reveal the global influence of sea level and climate on groundwater depths across several regions and ecosystems.

## Stealth Delivery

Delivery of therapeutics and imaging agents is hampered by the ability of the innate immune system to recognize and clear foreign particles. "Self" cells are protected from phagocytic clearance by the membrane protein CD47 that interacts with signal regulatory protein-α (SIRPα) on macrophages. Taking advantage of this protective strategy, **Rodriguez *et al.*** (p. 971) labeled nanoparticles with computationally designed minimal human-CD47–based peptide (hCD47). When injected into a strain of mice in which macrophages expressed a SIRPα that cross-reacts with hCD47, the peptide prevented clearance of nanoparticles and enhanced drug delivery to tumors.

## Assessing Singletons

The one-child policy introduced by the government of China in 1979 increased the proportion of urban families with an only child; later referred to as "little emperors" in media reports. In 2010, **Cameron *et al.*** (p. 953, published online 10 January) recruited approximately 400 residents of Beijing who had been born either before the implementation of the policy (1975 and 1978) or after (1980 and 1983). Using economic games to measure trust, risk, and willingness to compete, they found that the post-1979 cohorts were less trusting and less willing to compete and also more risk averse.

## Light On Clusters

From schools of fish to bacterial colonies, large-scale phenomena—such as swarming or pattern formation—are ubiquitous. In such systems, there is a continuing question as to the relative importance of "intelligence" (biology) of the agents versus purely physical effects. Working with synthetic colloids, **Palacci *et al.*** (p. 936) show that self-organized clustering can be switched on and off to form crystals that dissolve when the light source is turned off. The particles consist of a hematite cube partly encapsulated in a polymeric sphere that is able to catalyze chemical reactions when exposed to light. The self-assembly behavior results from a combination of propelling forces, osmotic effects, and coupling between colloidal and tracer particles.

*Additional summaries*

## Know Your Place

In the second installment of the "How Cells Know" series (see also **Chan and Marshall**, 7 September, 2012), **Lander** (p. 923) reviews what we know—and what we do not yet know—about the ways in which cells process information to adopt an appropriate differentiated state according to their position in a developing organism. How does nature accommodate the challenging trade-offs of engineering, where optimizing one process normally decreases performance of another? Only accurate and highly reproducible solutions can account for the ability of complex animals to develop correctly.

## Pressing Pause

The pausing of RNA polymerase II (Pol II) near promoters is an important and distinct regulatory step in the process of transcribing DNA into RNA. Although protein factors and DNA elements involved in pausing have been identified, the post-initiation events that lead to pausing are poorly understood. **Kwak *et al.*** (p. 950) present an approach, termed PRO-seq, for monitoring the position of actively transcribing RNA polymerase with single-nucleotide precision. The approach was used to explore the mechanism of promoter proximal pausing and showed that precise positioning between core promoter elements and the pause site is critical. The findings show how the promoter dictates transcriptional pausing and detects the preferential localization of active transcription complexes within the genome.

## Caspase-11–Dependent Pyroptosis

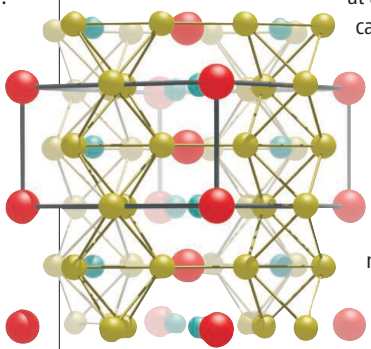
Inflammasomes are multiprotein complexes that assemble to initiate immunity to a variety of microorganisms, as well as to sterile tissue injury. Although a role for caspase-1 downstream of inflammasomes is well characterized, the discovery that caspase-1 knockout mice were also deficient in caspase-11 has led to a reassessment of the function of caspase-11. **Aachoui *et al.*** (p. 975, published online 24 January; see the Perspective by **Cemma and Brumell**) now demonstrate that caspase-11 is required for immunity against cytosolic bacteria in mice. Only bacteria that were able to access cytosol-activated caspase-11–dependent pyroptosis, an inflammatory type of cell death. This function of caspase-11 appeared to be independent of canonical inflammasomes.

## Promoter Mutations and Cancer

Cancer genome sequencing projects have highlighted the pathogenic role of recurrent mutations within the protein-coding regions of genes. Now, two studies suggest that the scope of mutations in human tumors extends to gene regulatory regions. In a study of 70 melanomas, **Huang *et al.*** (p. 957, published online 24 January) found that 71% harbored one of two specific mutations in the promoter region of *TERT*, the gene coding for the catalytic subunit of telomerase, the enzyme that caps chromosome ends. Independently, **Horn *et al.*** (p. 959, published online 24 January) identified a disease-segregating germline mutation in the *TERT* promoter in a family predisposed to melanoma and found additional *TERT* promoter mutations in a high percentage of sporadic melanomas and melanoma cell lines. The mutations in both studies generated new binding sites for specific transcription factors and, in reporter assays, caused an increase in transcription.

## Arsenic Makes a Difference

A quantum critical point (QCP) occurs when quantum fluctuations, which do not go away even at absolute zero, cause a gradual (so-called second order) phase change. QCPs have been observed in ferromagnets, but for ferromagnetic metals, the evidence is less clear-cut and it is thought that, as the temperature is lowered, another order—such as superconductivity—will prevent the formation of a QCP. However, **Steppke *et al.*** (p. 933), using specific heat and magnetic susceptibility measurements, found strong evidence for a QCP in a quasi–one-dimensional heavy fermion material, $YbNi_4(P_{1-x}As_x)_2$, near an Arsenic substitution level of about 10%. The results present a challenge to theories about quantum criticality in ferromagnets.



CREDIT: STEPPKE *ET AL.*