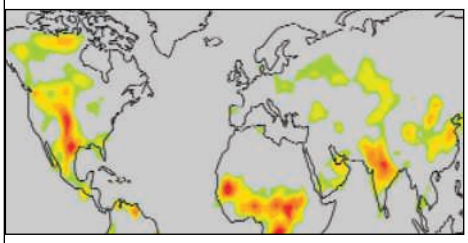
edited by Stella Hurtley and Phil Szuromi

The Dirt on Rain Forecasting

One of the most important controls on precipitation is soil moisture, because the water in soils is eventually returned to the atmosphere by evaporation, thereby providing water that once more will fall as rain. **Koster *et al.*** (p. 1138) describe the results of a multimodel intercomparison project designed to identify regions in which precipitation is most affected by soil moisture during summer in the Northern Hemisphere. They construct a global map of the strength of the distribution of land-atmosphere coupling, an essential step for producing better seasonal rainfall forecasts.



Making Bosons Mimic Fermions

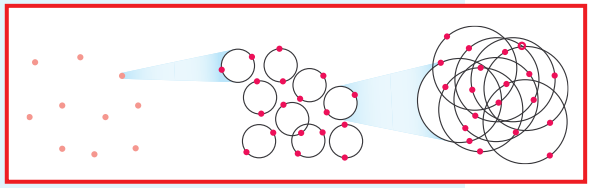
In three dimensions, an ensemble of weakly interacting bosons can condense into a single quantum state, or Bose-Einstein condensate (BEC). However, when the atoms are confined to one dimension, theory predicts that the interaction strength between the atoms can be varied so that they become strongly interacting. In that case, the wave functions of the atoms will become spatially distinct, and the bosons should start to repel each other, and essentially act like non-interacting fermions. This condition is known as the Tonks-Girardeau (TG) regime. **Kinoshita *et al.*** (p. 1125, published online 29 July 2004) optically confined an ensemble of bosonic rubidium atoms and varied the interaction strength between the atoms by adjusting the trap conditions. They can move the ensemble from the BEC regime into the TG regime, confirming the theoretical predictions made some 40 years ago.

Developing Zn(I) Chemistry

Although mercury and cadmium form compounds in +1 oxidation state, similar compounds for zinc, the first-row member of the Group 12 elements, are unknown outside of the solid state. **Resa *et al.*** (p. 1136; see the Perspective by **Parkin**) now report that a dimeric Zn(I) unit is present in the metallocene compound $Zn_2(\eta^5\text{-}C_5Me_5)_2$, where Me is a methyl group. Their characterization and reactivity data are more consistent with this formulation than with a hydride-bridged Zn(II) complex.

Superfluid Fermi Gases

The ability to tune the interaction strength between atoms within strongly interacting Fermi gases provides a potentially powerful experimental system in which to study many-body physics. One example is the crossover from a Bose-Einstein Condensate (BEC) regime, in which the atoms are strongly coupled into pairs, to the weak-coupling regime that mimics Bardeen-Cooper-Scheiffer (BCS) coupling of electrons in superconducting metals (see the Perspective by **Ho**). **Chin *et al.*** (p. 1128, published online 22 July 2004) present a spectroscopic study of a two-component Fermi gas as the interaction strength is systematically changed in this crossover regime. A gap develops in the excitation spectrum that is indicative of the formation of a fermionic superfluid. **Kinunnen *et al.*** (p. 1131, published online 22 July 2004) provide further insight by describing a theoretical framework in which the experimental results are explained.



Secondary Staining of Steel

The initiation of pitting corrosion in metals occurs at sites of impurities or other defects. After an initial reaction, these sites become inactive, but in some cases, corrosion can restart. **Punckt *et al.*** (p. 1133) show that the rapid onset of the secondary corrosion occurs because a small change in local chemistry causes some corrosion sites to reactivate, thereby triggering a cascading process. This direct visualization method may prove helpful in identifying ways to prevent the rapid onset step, which may differ from one steel to the next.

Curiouser and Curiouser

The Ediacaran fauna of the Neoproterozoic era bear little resemblance to anything found several tens of millions years later in the Cambrian or, indeed, at any other time in Earth's history. As such, these first complex organisms provide a challenge to understanding animal ancestry. **Narbonne *et al.*** (p. 1141, published online 15 July 2004; see the cover and the Perspective by **Brasier and Antcliffe**) have discovered an exceptionally well-preserved collection of Ediacaran fauna in Newfoundland. The Mistaken Point assemblage—the oldest reliably dated examples of the Ediacaran biota—features a variety of "rangeomorph" forms, including fractal-like "leaves" or "branches" on stalks that have holdfasts that were probably tethered to the sea floor. Unlike previous two-dimensional impressions, these fossils are preserved in three dimensions, with features resolved down to 30 micrometers. The fossils also reveal internal structures that further demonstrate the distinctive position of these long-extinct animals in evolutionary history.

The Path to Maturity

To efficiently activate T cell immunity, dendritic cells (DC) must undergo a program of maturation steps to allow them to become proficient at taking up antigen and activating T cells. **West *et al.*** (p. 1153) observe that DC maturation includes a previously unappreciated early acute response after activation via Toll-like receptors. A transient phase of endocytosis that involved redeployment of the actin cytoskeleton ultimately led to increased antigen presentation. **Benvenuti *et al.*** (p. 1150) show that at a later stage of maturation, DC use the guanosine triphosphatases Rac1 and Rac2 to extend the cytoskeleton to form critical membrane contacts with activating T cells. The two studies reveal a dynamic and

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highly regulated orchestration of actin cytoskeleton deployment at distinct stages of the DC activation program.

Making the Cut Inside of Membranes

Proteases residing in cellular membranes can hydrolyze the peptide bonds of their substrates despite their water-excluding environment. **Wolfe and Kopan** (p. 1119) review the similarities and differences between these intramembrane proteases and their better-characterized soluble cousins. Identifying the substrates of these intramembrane proteases and the catalytic mechanisms through which they hydrolyze substrate peptide bonds within membranes will enable a better understanding of how these proteases regulate crucial biological processes and how abnormal forms may contribute to disease.

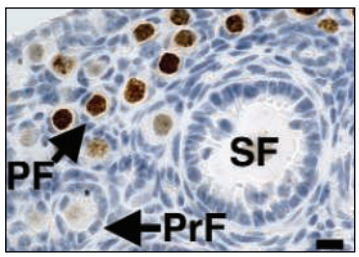
Aching Muscles and Acidosis

Muscle fatigue has long been thought to result from the accumulation of lactic acid, a product of anaerobic metabolism. But does fatigue occur because of—or actually in spite of—lactic acid accumulation and consequent decreased pH? **Pederson *et al.*** (p. 1144; see the Perspective by **Allen and Westerblad**) used a preparation of skinned rat skeletal muscle fibers to manipulate key steps in the excitation contraction coupling process. Acidification actually provides a protective effect, such that chloride permeability is decreased, which allows enhanced force generation in response to depolarizing stimuli. Thus, acidosis is probably not the most important factor in reduced muscle performance due to fatigue.

Good Vibrations?

The mechanical properties of cellular substructures are important in many biological processes. **Pelling *et al.*** (p. 1147) have used atomic force microscopy to measure periodic motions in the cell wall of living *Saccharomyces cerevisiae*. The motion ceases when yeast cells are exposed to a metabolic inhibitor, which suggests that active metabolic processes drive the nanomechanical motion. The frequency in the range from 0.8 to 1.6 kilohertz is consistent with the operating speeds of molecular motors such as kinesin, dynein, and myosin. The forces at the cell wall are too large for the motion to be driven by a single motor protein, but the motion may result from the concerted action of molecular motor proteins.

No Nobox, No Ovaries



In mice, the female germ cells are surrounded by somatic granulosa cells to form the ovarian follicle. Although several genes have been shown to function in the primordial to primary transition of follicles, relatively little is known about factors involved in early folliculogenesis. **Rajkovic *et al.*** (p. 1157) now show that the oocyte-specific homeobox gene Nobox is crucial for this early stage. Mutant female mice lacking Nobox have atrophic ovaries, with gradual loss of oocytes by 14 days postpartum, and are infertile.

Stayin' Alive

About 10% of patients with non–small cell lung cancer (NSCLC) experience dramatic tumor regression when treated with Gefitinib (Iressa), a recently approved drug that inhibits the kinase activity of the epidermal growth factor receptor (EGFR). Tumors that respond to Gefitinib harbor somatic mutations in the EGFR kinase domain. **Sordella *et al.*** (p. 1163, published online 29 July 2004) now show that these mutant EGFRs activate a signaling pathway that keeps the tumor cells alive even when they are treated with agents that induce cell death, such as conventional chemotherapeutic drugs. The authors speculate that NSCLCs expressing the mutant EGFRs may become fully dependent on this cell survival pathway, which could explain, at least in part, their extreme sensitivity to Gefitinib.

CREDIT: RAJKOVIC *ET AL.*

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