**OPTICS**

**Optical Conservation**

In the interests of conservation, historical research, and attribution, paintings in museums may be subjected to a barrage of scientific probes, each of which is sensitive primarily to surface or subsurface features; sometimes, small samples are physically removed from the painting for analysis. The development of techniques that are nondestructive and noninvasive is not only desirable but also necessary when it comes to examining old and delicate pieces. The optical interferometric technique of optical coherence tomography (OCT) is usually associated with the three-dimensional imaging of biological samples, particularly the inner structure of the eye. Liang *et al.* show that OCT can also be used for the noninvasive examination of paintings to provide high-resolution and dynamic imaging capabilities for visualizing the structures of layers of varnish, layers of paint, and even the preliminary sketches underneath. This imaging technique should prove to be a useful tool for the conservation and attribution of art. — ISO


**CELL BIOLOGY**

**A Tale of Two Signals**

The intracellular transport of membrane proteins requires cellular machinery that recognizes targeting signals that may be present within the cytoplasmic, membrane, or extracellular domains of the protein. But some proteins contain multiple targeting signals, which need to be decoded sequentially to execute the correct protein itinerary. Anderson *et al.* have examined the signals in NgCAM, a cell adhesion molecule that is generally found in the axonal membrane of neurons, but is first transported to the dendrites. When expressed in an epithelial cell line, NgCAM is transported to the basolateral plasma membrane and then transcytosed to the apical surface, where it remains despite multiple rounds of endocytosis and reinsertion into the apical membrane. Why then, after endocytosis, does the protein not go back to the basolateral surface? The signal for basolateral targeting resides in the cytoplasmic domain of NgCAM and is recognized by an adaptor protein that ensures delivery of newly synthesized protein to the basolateral surface. This signal is masked by phosphorylation of a key tyrosine residue, which uncovers a cryptic apical targeting signal in the extracellular domain and also maintains the protein within a recycling cycle at the apical surface. — SMH


**CLIMATE SCIENCE**

**The First of Many?**

The first hurricane ever documented in the South Atlantic, Catarina, struck the southern coast of Brazil on 28 March 2004. This unprecedented event led some Brazilian meteorologists to deny that it was a hurricane at all; further analysis, however, has shown that it was.

In a detailed study of the storm, Pezza and Simmonds describe its evolution from genesis on 20 March 2004 as an extra-tropical cyclone, through its strengthening to a category I hurricane before it drifted over land. This hurricane developed because of an unusual combination of high sea surface temperatures, low vertical wind shear, and strong mid-to-high latitude blocking (which interferes with normal east-west atmospheric flow). These conditions are functions of large-scale atmospheric circulation patterns in the region and could be related to climate change. If so, more hurricanes may occur in the South Atlantic in the future. — HJS


**IMMUNOLOGY**

**Returning the Complement**

Many an immunology undergraduate's headache can be traced to memorizing the intricacies of the complement system. Three activation pathways lead to the generation of the C3 converting enzymes, which are responsible for generating the effector molecules that carry out crucial host defence functions. As a result, the complement system is a target for viral and bacterial evasion strategies.

The bacterial pathogen *Staphylococcus aureus* has evolved a bacteriophage-encoded pathogenicity gene cluster (SaP15) that is present in 90% of strains and encodes four secreted human-specific virulence proteins. Rooijakkers *et al.* observed that one of these, designated SCIN, inhibited bacterial phagocytosis by human neutrophils, by blocking the deposition of the complement factor C3b on bacterial membranes, which is a crucial step in opsonization. Further upstream, SCIN could inhibit all three pathways by binding to the C3 convertases (C4b2a and C3bBb). Potentially, such interactions could alter the intrinsic decay potential of the convertases, which activate downstream effector molecules of the complement pathway. As a consequence, SCIN has the ability to interfere with the complement system at multiple points, making it a drug development target for diseases involving aberrant complement activity. — SJS


**MATERIALS SCIENCE**

**A Sizeable Break**

Metals and alloys containing nanocrystalline-sized grains are of interest because of their superior strength, wear
resistance, and superplasticity, which is the ability to deform a material beyond its usual breaking point. When nanostructured metals are defect-free, they also show reasonable tensile elongations in addition to their enhanced strength. However, as the grain size decreases, the mechanism of plastic deformation changes from one that is dislocation-mediated to one that is grain boundary-mediated; it is not known if the failure mechanism changes from ductile to brittle, which might limit the applicability of these materials.

Li and Ebrahimi examined nanocrystalline nickel and nickel-iron alloys with grain sizes above and below the critical size, respectively. In tensile testing, the Ni specimen showed significant necking before fracture, indicative of ductile behavior. Examination of the fracture surface showed matching concave features on both halves, which is consistent with the formation of microvoids during deformation. In contrast, the NiFe alloy showed little necking, indicative of a much lower toughness. The fracture surface showed a cup and cone pattern, or a series of voids and protrusions. The authors attribute this cup and cone pattern to the meandering of the path, and hence the fracture to the breakage of atomic bonds rather than cavity growth. — MSL

**BIOCHEMISTRY**

**Two by Two**

Membrane proteins have never been easy to study, but two groups have applied modifications of soluble protein biochemistry to catalog protein–protein interactions in the membranes of *Escherichia coli* and *Saccharomyces cerevisiae*. Stenberg et al. use a two-dimensional (native/denaturing) electrophoretic system to identify 34 solubilized protein complexes from the bacterial inner membrane and 9 complexes from the outer membrane. Even though the complete sequence of the *E. coli* genome is available, the functional roles of many genes are not; the protein YhcB associates stoichiometrically with the two major subunits of cytochrome bd quinol oxidase and can now be assigned as a subunit of this enzyme. Miller et al. use the split-ubiquitin yeast two-hybrid system to enumerate almost 2000 interactions involving roughly 500 integral membrane proteins. Unlike the stable complexes isolated by detergent solubilization, this approach probably picks up transient interactions as well, and correlating the two-hybrid results with bioinformatic and experimental data led to their classification into confidence categories, of which 131 interactions were most likely to represent true positives. — GJC


**Spliced in the Cytoplasm**

In nucleated cells, noncoding introns are removed from pre-messenger RNA (pre-mRNA) transcripts by the spliceosome (a nuclear complex of proteins and RNAs) before export of the mRNA from the nucleus. Thus, one would not expect that platelets—anucleate blood cells that bud from megakaryocytes—would contain spliceosome components or pre-mRNAs. Nevertheless, Denis et al. show that components of the spliceosome are present in the cytoplasm of human megakaryocytes and also in circulating platelets. Interleukin-1β (IL-1β) pre-mRNA is present in the cytoplasm of quiescent platelets, whereas platelets that had been activated by adhesion to fibrinogen in the presence of thrombin contain mature IL-1β mRNA and protein. Moreover, IL-1β pre-mRNA could be converted into mature mRNA by a platelet extract. Thus, pre-mRNA splicing is a key regulatory point for cytokine production during platelet activation. — EMA