BIOMEDICINE

Remodeling the Joint

Rheumatoid arthritis is a debilitating autoimmune disorder that is characterized by a profound remodeling of tissue architecture at the joint, which results, most notably, in a permanent loss of bone. Therapies that reduce joint inflammation have been somewhat successful in delaying the onset and progression of the disease, but they have not been able to reverse joint damage once it has occurred. Because the recovery of joint function in rheumatoid arthritis will probably require therapeutic approaches that trigger the formation of new bone, there is growing interest in understanding the molecular mechanisms that regulate bone remodeling within the joint.

Following up on previous evidence that identified the Wnt signaling pathway as a determinant of bone mass, Diarra *et al*. investigated whether manipulation of this pathway would affect joint pathology in mice overexpressing the pro-inflammatory molecule tumor necrosis factor–α (TNF-α), a widely used animal model of human rheumatoid arthritis. They found that the antibody-mediated blockade of Dickkopf-1 (DKK-1), which is an endogenous inhibitor of Wnt signaling, induced the formation of osteophytes (bone spurs) at the inflamed joints and also prevented the resorption of bone by specialized cells called osteoclasts. As was consistent with the mouse data, they observed that DKK-1 was expressed at aberrantly high levels in joint specimens from humans with rheumatoid arthritis and that in both species DKK-1 expression was induced by TNF-α. These results identify the Wnt pathway as an important regulator of joint remodeling in rheumatoid arthritis. Because Wnt signals influence both the formation and the destruction of bone, future therapies targeting this pathway could in principle be applied not only to rheumatoid arthritis, which is characterized by bone loss, but also to osteoarthritis and other diseases of the joint. — PAK

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ECOLOGY/EVOLUTION

No End of History

Teasing apart the relative roles of historical and contemporary climatic elements in determining species richness is one of the core quests of biogeographical research. Hitherto, success has been limited because of the correlative nature of models used. Rahbek *et al.* have developed a new class of spatially explicit, mechanistic models that use individual species distributions as a basic currency. Application of these predictive models to the distributions of birds in South America shows that current climate explains the distributions only of the most widespread species. Their results indicate that historical factors and community assembly processes may be more important in determining the distributions of species with narrower ranges; these species

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standing still, is a cornerstone of special relativity. However, some researchers believe that there may be extremely small violations of Lorentz symmetry which, if measured, could provide tests of string theory and quantum gravity.

Experiments are now underway to search for Lorentz violations by trapping antihydrogen atoms. Altschul has calculated the properties of another possible experimental test known as vacuum Čerenkov emission. High-energy charged particles passing through matter give off light, such as the eerie blue glow of radioactive waste in a storage pool. If Lorentz symmetry is violated, particles moving through empty space may also emit Čerenkov light. Observing such emission would be extremely difficult but could serve as a valuable complement to the antimatter experiments. — DV

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OCEAN SCIENCE

Singing Vents

Mid-ocean ridges are dotted with hydrothermal vents termed black smokers. From these towers, dark streams of mineral-laced hot water bubble out to enrich the deep ocean and provide niche environments for many organisms. Little is known, however, about the patterns of hydrothermal flow from individual vents. As a means of monitoring the flow, Crone *et al.* have recorded the sounds of two black smokers, "Sully" and "Puffer," on the Juan de Fuca ridge 2200 m below the ocean surface. Submerged acoustic sensors provided close to 200 hours of recorded data. Both vents proved noisy, exceeding the ambient level by 10 to 30 dB. Broadband acoustic signals were measured at frequencies up to 500 Hz, possibly generated from a combination of volume changes in the flow, turbulence enhanced by fluid heterogeneity, and chimney vibration. Single tones sang out over the top, perhaps indicating resonant frequencies of the cavities. The authors speculate that such sounds could be used by organisms living near black smokers for navigation and to avoid the scorching water. — JB

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