PARASITOLOGY

Infection in Real Time

Malaria parasites (Plasmodium) are injected into the mammalian bloodstream by mosquitoes, and the sporozoites travel to the liver, where they elude host immune responses and grow. Frevert et al. have taken a technically sophisticated approach to visualizing parasite infiltration of the liver in real time. Mosquitoes, infected with red fluorescent protein–labeled parasites, were continuously fed on a mouse engineered to express green fluorescent protein in cells of the liver sinusoids. Simultaneously, the mouse was held on the stage of a fluorescence microscope, and a lobe of the liver was exposed through the abdominal wall so that the route of the parasites could be monitored. The sporozoites could be seen to glide across the surface of the sinusoidal epithelial cells, to slow down and enter the Kupffer cells, and to use these as a bridge into the liver parenchyma. For up to 15 min, sporozoites traversed destructively through hepatocytes, leaving a trail of necrosis, until finally halting within a hepatocyte and replicating. During these journeys, parasites leave a trail of surface proteins, which tolerize the already immunologically lax Kupffer cells and hence help to shield the invader from host responses. — CA


GEOLOGY

Limits to Weathering

Chemical weathering of silicate minerals removes CO₂ from the atmosphere and therefore provides a key feedback that regulates Earth’s climate over long time scales. The rate at which this process proceeds depends on the atmospheric concentration of carbon dioxide, temperature, topography, rainfall, and vegetation; the interaction of all of these factors has made it difficult to establish their separate contributions.

West et al. present a compilation of chemical and physical erosion rates in small river catchments and interpret those data with a model for quantitatively discriminating between the controls on silicate weathering by erosion, runoff, and temperature/vegetation in modern environments. They find that silicate weathering is proportional to mineral supply, which limits weathering at lower erosion rates; at higher erosion rates, climatic factors such as temperature and runoff-related kinetics control the rate of weathering. — HJS


CHEMISTRY

Reactive Nanoassembly

One route toward creating nanostructures is first to self-assemble molecules through multiple weak interactions and then to cross-link pendant groups to create stable covalently bonded structures. Jin et al. report on a case where the components fail to assemble into larger structures until cross-linking reactions are initiated. Previously this group had shown that large aromatic groups (hexabenzoconorrones) bearing alkyl and triethylene glycol groups could form graphitic nanotubes that were held together by non-covalent interactions. However, when these molecules were derivatized to add reactive propenyl groups onto the glycol chains, no assembly into nanotubes occurred during solvent evaporation. However, when a Ru acyclic diene metathesis catalyst was added to the CH₂Cl₂ solution, ethylene was released and nanosheets formed. — PDS


EDITORS’ CHOICE

Giving Stem Cells a Chance

Many important issues surround stem cell and gene therapies, including at what time after birth treatments should be assessed and implemented. This timing is influenced by how early a disease manifests and whether it is considered sufficiently severe to warrant the risk of early intervention.

Escolar et al. provide an example of how very early stem cell therapy can enhance the chance of success. The study group consisted of newborns suffering from Krabbe’s disease, a rare genetic disorder in which loss of a lysosomal enzyme in cells resident in the central nervous system allows the lipid substrates to accumulate, which results in severe neurologic deterioration and death. In an attempt to correct this deficiency, stem cells from banked umbilical cord blood of unrelated donors were transplanted into newborns who either had already started to develop symptoms (142 to 352 days old) or had a family history of the disease but were as yet asymptomatic (12 to 44 days old). In the latter group, survival and neurologic development were significantly improved for almost all graft recipients, with cognitive functions in the normal range. Presymptomatic therapy in this case is likely to have allowed more efficient stem cell replacement of defective resident cells, thus avoiding some of the early toxic effects of the lipid substrates on young neurons and immature neural tracts. — SJS


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Life is full of “what-ifs,” yet each of us has to collapse multiple uncertainties into a binary yes/no in order to be able to make any decisions at all. Yu and Dayan have constructed a computational model that combines two types of uncertainty—the first incorporates the predictive value of a validated cue, and the second quantifies the likelihood that the existing cue is no longer valid and that a new one needs to be identified—and propose that these are encoded by the neuromodulators acetylcholine (ACh) and norepinephrine (NE); to be precise, by cholinergic and noradrenergic circuits, respectively. In their generalized Posner task, a red arrow points toward the side where the target will appear most of the time, whereas arrows of other colors are randomly oriented. As the predictive value of the red arrow declines, acetylcholine increases. At unspecified times, the red arrow stops carrying information, and another arrow becomes the predictive cue. During this changeover, norepinephrine increases, signaling the need to search for the cuing color. When the exquisite balance of these systems is disrupted, inappropriate behaviors ensue: A drop in norepinephrine leads to perseverence and a lack of adaptability; conversely, a drop in acetylcholine results in hyperdistractability. — GJC


**ECOLOGY/EVOLUTION**

**Not Just a Hanger-On**

Among the many characteristic features of tropical forests are large lianas (woody vines) that loop through the canopy and the understory. Unlike trees, they defy easy quantification and so have tended to receive less attention in ecological studies of forest structure and dynamics.

Phillips *et al.* have redressed the balance in a study of liana dynamics in western Amazonian forests, using (i) time series of data on the turnover (defined as death and replacement) of liana and tree stems collected over periods of one to two decades at a number of forest sites, and (ii) a structural inventory of all lianas in an intensively sampled 1-ha plot in southern Peru. The long-term turnover rates of large lianas (with stems >10 cm in diameter) were rapid—about three times those of trees—with annual recruitment and mortality rates exceeding 6%. Infestation with large lianas was associated with higher death rates in canopy trees, though it is difficult to disentangle cause and effect: Liana infestation may hasten death, yet older trees will have been hosts to lianas for longer. Forest primary productivity was also positively associated with liana turnover rates. Although the biomass of lianas is small relative to that of trees, lianas appear to play a disproportionately active role in forest dynamics. — AMS