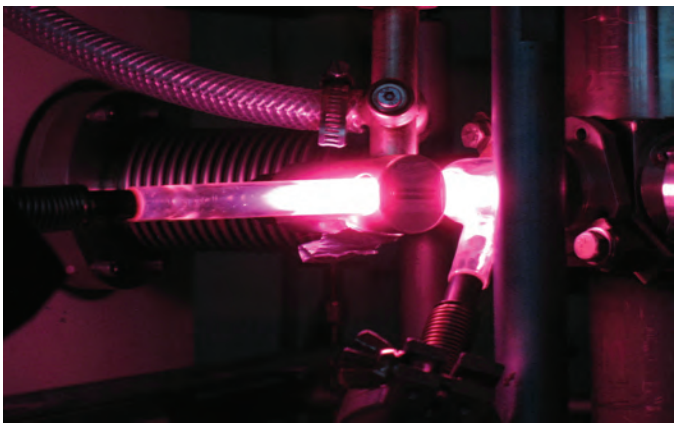
In This Issue

Interstellar ices and prebiotic ribonucleotide intermediates

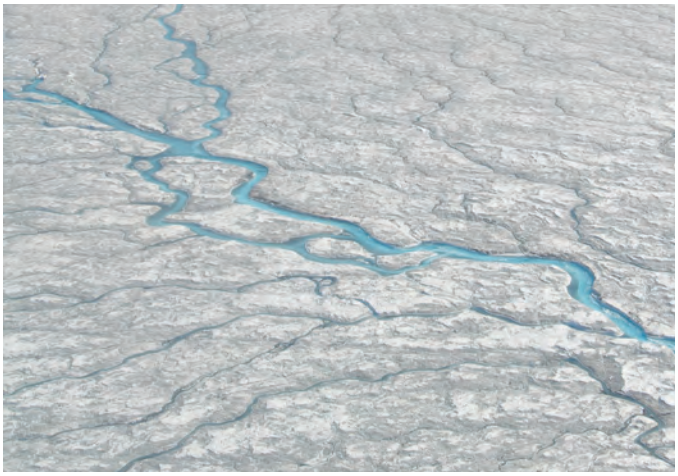
In the dense molecular clouds from which stars and planetary systems form, interstellar ices represent the most abundant molecular species in the solid state. Subjected to various energetic and thermal processes, these ices undergo transformations that ultimately lead to new and complex molecules. Using laboratory experiments, Pierre de Marcellus et al. (pp. 965–970) reproduced the processes by which these ices evolve, and having previously identified amino acids in the organic residues, searched for different families of molecules of interest to prebiotic chemistry. The authors found 10 members of the aldehyde class of organic compounds, including glycolaldehyde and glyceraldehyde, two sugar-related species thought to be intermediates in the synthesis of ribonucleotides in planetary environments. This material, incorporated into planetesimals at the origin of the organic matter in the Solar System, represents a potential source of prebiotic chemistry on telluric planets. The findings represent a means by which comets and primitive meteorites could have seeded the Earth with organic material as early as 4.2 billion years ago, according to the authors. — T.J.



Ultraviolet processing of cosmic ice analogs.

Estimating Greenland meltwater release

Every summer, melt-prone areas on the Greenland Ice Sheet form a complex system of supraglacial streams, rivers, and moulins that drain and transport surface meltwater to the ocean. Although this runoff contributes significantly to rising global sea level, few observational studies have examined the system in detail. Laurence Smith et al. (pp. 1001–1006) used satellite mapping and in situ measurements to assess drainage on the ice sheet's southwestern ablation surface following a period of extreme melting



Supraglacial rivers on melt-prone areas of the Greenland Ice Sheet surface are an important component of Arctic climate change.

in 2012. The authors found that under optimal conditions the drainage system captures virtually all surface melt and can flush the entire volume in less than 2 days. However, measured outflow from Isortoq, a large proglacial melt-fed river exiting the ice sheet, tended to be lower than simulated discharge from an established regional climate model. This latter finding suggests that some meltwater from the surface can be stored beneath the ice sheet even in regions of peak melting and transport. The study documents the importance of supraglacial river drainage and suggests that climate models may overestimate meltwater release from the ice sheet if they fail to account for subglacial processes. — T.J.

How early vertebrates evolved fast neuronal signaling

Around 420 million years ago, the neurons of jawed fish evolved specialized, excitable parts called axon initial segments and nodes of Ranvier, which allowed thin nerve fibers called axons to generate and rapidly conduct electrical signals over long distances. This innovation allowed vertebrates to develop miniaturized but highly integrated central nervous systems while achieving unprecedented body sizes. Paul Jenkins et al. (pp. 957–964) provide evidence that a protein called giant ankyrin-G (AnkG) is required for the assembly of axon initial segments and nodes of Ranvier and thus is a master organizer of excitable axon segments. The authors found that cultured neurons deficient in giant AnkG did not show proper clustering of key protein components of the axon initial segment, in contrast to neurons with normal levels of giant AnkG. Moreover, genetically modified mice deficient in giant AnkG exhibited an 80% reduction in the number of nodes of Ranvier in a brain

structure called the corpus callosum, as well as altered synchronization of neuronal activity in a brain region called motor cortex, compared with normal mice. Because excitable axon segments are involved in human disorders such as epilepsy and psychiatric diseases, the authors suggest that giant AnkG could be a potential target for the treatment of conditions affecting cognitive ability, behavior, and neurological function. — J.W.

Understanding mass mortality events

Mass mortality events (MMEs) are rare instances of high mortality within a population that affect individuals across all age classes. While MMEs have been documented throughout recorded history, their causes and frequencies are poorly understood. Samuel Fey et al. (pp. 1083–1088) analyzed 727 MMEs that were documented since 1940 in the scientific literature and that affected 2,407 animal populations around the world, including invertebrates, reptiles, amphibians, birds, fish, and mammals. The authors observed an overall increase in MMEs from 1940 to the present. But different animal groups displayed different trends in MME incidence, including increases for invertebrates, birds, and fish,

Image courtesy of Gary Mittelbach (Michigan State University, East Lansing, MI).

Mass mortality event of fishes.

decreases for reptiles and amphibians, and a stable incidence for mammals. Increases in the number of MMEs correlated with increasing rates of disease, biotoxicity, and events caused by multiple interacting stressors. The largest magnitude MMEs also appeared to be those caused by multiple interacting stressors, starvation, or disease. According to the authors, the results provide a preliminary understanding of contemporary trends and causes of MMEs and may help reveal how perturbations to natural ecosystems may alter the incidence of MMEs. — J.P.J.

Parsing a paradox underlying type 2 diabetes

The selective nature of hepatic insulin resistance in type 2 diabetes, wherein the insulin-resistant liver continues to produce triglycerides even as it fails to suppress glucose production, has long mystified researchers. The imbalance culminates in hyperglycemia, hyperlipidemia, and hepatic steatosis. Past studies have attempted to find a branch point in insulin signaling where

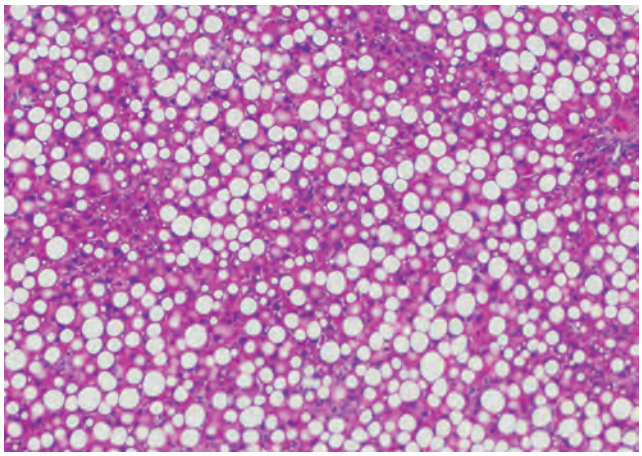


Image courtesy of Rachel Perry (Yale University, New Haven, CT).

Fatty liver from a rat model of nonalcoholic fatty liver disease.

hepatic glucose and lipid metabolism diverge. Daniel Vatner et al. (pp. 1143–1148) propose that hepatic triglyceride synthesis from preformed fatty acids occurs independently of hepatic insulin signaling and is predominantly regulated by fatty acid delivery to the liver. To test the hypothesis, the authors developed a liquid chromatography-tandem mass spectrometry method to directly measure the rates of fatty acid esterification into hepatic triglyceride in normal rats, insulin-resistant rats fed a high-fat diet, and rats treated with an insulin receptor 2′-*O*-methoxyethyl chimeric antisense oligonucleotide. In contrast to hepatic de novo lipogenesis, the authors found that the rates at which fatty acids were transformed into triglycerides primarily depended on fatty acid delivery and occurred independently of hepatic insulin action. According to the authors, the findings might explain how increased hepatic triglyceride synthesis occurs in the presence of hepatic insulin resistance. — A.G.

eReading before bed

Dim light in the evening allows for the production of melatonin, which regulates sleep. To examine the effect of bright artificial light, such as that produced by light-emitting electronic readers, on sleep rhythms, Anne-Marie Chang et al. (pp. 1232–1237) compared the quality of sleep that follows the use of an eReader before bed with the quality of sleep that follows reading a printed book before bed. Over a 14-day study period, 12 participants read for 4 hours before bed in dim light for 5 consecutive days using a light-emitting eReader, and also read a printed book before bed for 5 consecutive days under similar conditions. Participants reported their level of drowsiness in the evenings and level of wakefulness in the mornings after a proscribed 8-hour sleep period. The authors also assessed participants' levels of melatonin hourly. Participants reported longer times to fall asleep, reduced evening drowsiness, and reduced morning wakefulness after reading from eReaders than after reading a printed book. The authors found that use of a light-emitting eReader suppressed melatonin production in the evening, shifted circadian sleep/wake rhythms, and affected time to fall asleep as well as next-morning wakefulness. The results suggest a link between the use of eReaders and other light-emitting electronics and health, according to the authors. — P.G.