

CANCER**To respond or not to respond**

Patients with cancer are frequently treated with chemotherapy, but it does not always work and it is difficult to predict who will respond to the treatment. In addition to the direct effects of chemotherapy, antitumor immune responses can also play an important role. By examining the immune responses in patients with muscle-invasive bladder cancer, Vollmer *et al.* identified a key role for the CXCR3 chemokine system of ligands and receptors. The activity of this system before initiation of treatment was associated with subsequent response to chemotherapy in multiple independent cohorts of patients, suggesting a potential rational approach to the selection of therapies. —YN and MN *Sci. Transl. Med.* **13**, eabb3735 (2021).

MULTIPLE SCLEROSIS
Precision therapy for immune tolerance

Autoimmune diseases, such as multiple sclerosis (MS), result from a breach of immunological self-tolerance and tissue damage by autoreactive T lymphocytes. Current treatments can cause systemic immune suppression and side effects such as increased risk of infections. Krienke *et al.* designed a messenger RNA vaccine strategy that lacks adjuvant activity and delivers MS autoantigens into lymphoid dendritic cells. This approach expands a distinct type of antigen-specific effector regulatory T cell that suppresses autoreactivity against targeted autoantigens and promotes bystander suppression of autoreactive T cells against other myelin-specific autoantigens. In mouse models of MS, the vaccine delayed the onset and reduced the severity of established disease without showing overt symptoms of general immune suppression. —PNK

Science, this issue p. 145

CHEMICAL PHYSICS**The nature of short hydrogen bonds**

Hydrogen bonding (H-bonding) unquestionably plays an important role in chemical and biological systems and is responsible for some of their unusual properties. Strong, short H-bonds constitute a separate class that, owing to their elusive characterization, has remained a point of contention over the past several decades. Using femtosecond two-dimensional infrared spectroscopy in conjunction with quantum chemical calculations, Dereka *et al.* demonstrate a powerful way to investigate the nature of short H-bonding (see the Perspective by Bonn and Hunger). Their quantitative characterization of multiple coupled motions in the model system of bifluoride anion $[F-H-F]^-$ in aqueous solution reveals several distinctive features of a crossover from conventional to short, strong H-bonding. —YS

Science, this issue p. 160
see also p. 123

OCEAN ANOXIA**Where they can't breathe**

Climate warming is causing the expansion of marine oxygen-deficient zones, which are regions in which dissolved oxygen concentrations are so low that many marine animals cannot survive. This phenomenon also might affect the global cycles of carbon, sulfur, nitrogen, and trace metals in the oceans. Raven *et al.* show how ocean anoxia affects microbial sulfur processing in sinking marine particles. They observed cryptic microbial sulfate reduction, which forms organic sulfur that is resistant to acid hydrolysis, a process that could enhance carbon preservation in sediments underlying oxygen-deficient water columns. This may help explain some of the more extreme episodes of organic carbon preservation associated with marine anoxia in Earth's history. —HJS

Science, this issue p. 178

IN OTHER JOURNALS

Edited by Caroline Ash
and Jesse Smith



Copepods use pheromone trails and hydrodynamic signals to track down females under turbulent conditions.

SYNTHETIC BIOLOGY
A microfactory in yeast peroxisomes

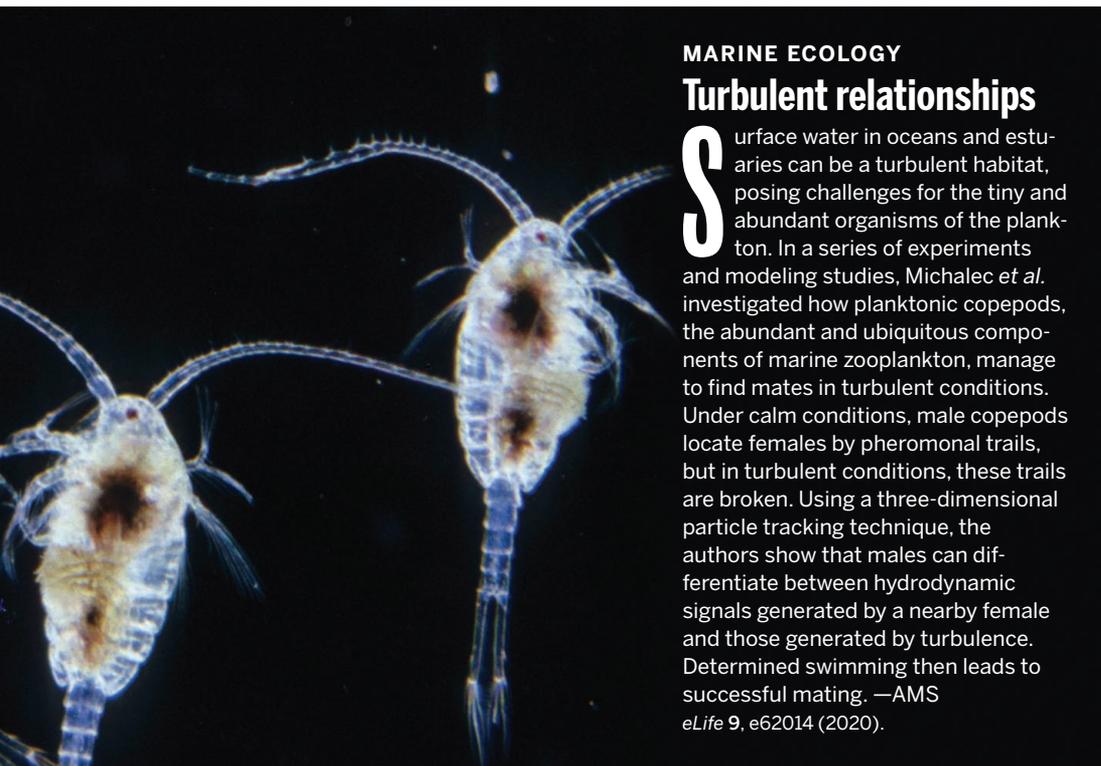
Considerable synthetic biology efforts are focused on engineering yeast to produce valuable metabolites. Production in the cytosol can be challenging because of toxicity or crosstalk with cellular pathways. Dusséaux *et al.* harnessed the yeast peroxisome to produce geranyl diphosphate (GPP), a precursor to monoterpenoids, monoterpene indole alkaloids, and cannabinoids. Targeting the entire pathway for GPP synthesis, along with an enzyme that converts GPP to the monoterpene limonene, to the peroxisome gives a 125-fold improvement in yield of limonene compared with production in the cytoplasm. Additional monoterpenes can be synthesized with the same platform using the appropriate monoterpene synthase. Peroxisomal production also facilitates downstream processing involving oxidation by cytochrome P450 enzymes. Peroxisome microfactories could be used

for the modular assembly and optimization of other complex pathways. —VV

Proc. Natl. Acad. Sci. U.S.A. **117**, 31789 (2020).

SCIENTIFIC WORKFORCE
Keep calm and measure the gap

Academic conferences are fertile ground for data collection on gender inequities, owing to their importance in career development, networking, and increasing visibility. Corona-Sobrino *et al.* developed a tool based on performance indicators that allows for real-time monitoring and evaluation of gender roles and inequities at academic conferences. In developing the tool, three relevant perspectives (participation, organizational structure, and attitudes) were identified, along with a specific list of performance indicators for each, allowing for both individual and combined analysis. Results are shown as a traffic light visualization, with red meaning bad and green meaning good, making



MARINE ECOLOGY

Turbulent relationships

Surface water in oceans and estuaries can be a turbulent habitat, posing challenges for the tiny and abundant organisms of the plankton. In a series of experiments and modeling studies, Michalec *et al.* investigated how planktonic copepods, the abundant and ubiquitous components of marine zooplankton, manage to find mates in turbulent conditions. Under calm conditions, male copepods locate females by pheromonal trails, but in turbulent conditions, these trails are broken. Using a three-dimensional particle tracking technique, the authors show that males can differentiate between hydrodynamic signals generated by a nearby female and those generated by turbulence. Determined swimming then leads to successful mating. —AMS *eLife* 9, e62014 (2020).

MATERIALS SCIENCE

Tuning boron-carbon-nitride films

Thin films formed from boron, carbon, and nitrogen (BCN films) can exhibit a wide range of optical and electronic properties if they can be made as phase-pure materials. Giusto *et al.* report on a simple solution-based route to hydrogenated BCN films. Gels formed with different melamine and boric acid ratios (1:1 and 2:1) were deposited on substrates and then heated in dry nitrogen to produce homogeneous, optically transparent films with optical bandgaps of 2.9 and 3.4 electron volts, respectively. The material derived from the 2:1 gel exhibited sp^2 bonding and avoided segregation into graphene and hexagonal boron nitride. Addition of small amounts of benzoguanamine to the gels allowed for additional compositional and bandgap tuning. —PDS

J. Am. Chem. Soc. **142**, 20883 (2020).

it easy to see which areas are, or are not, performing well. Recommendations are provided to ensure that one's academic conference stays in the green. —MMc

PLoS ONE **15**, e0243549 (2020).

SYMBIOSIS

Tiny tomato suppressor

Acarid arthropods are common and economically important pests of crop plants. The tomato russet mite *Aculops lycopersici* is only 175 micrometers long but can potently suppress the host plant's natural resistance. It has a highly streamlined genome of 32.5 megabases, more closely resembling that of a protist than a metazoan. Greenhalgh *et al.* discovered that this mite leaves no room in its genome for hangers-on. It contains few transposons, has slimmed intergenic spaces to almost none, has almost done away with chemosensory apparatus and detox pathways, and has even reduced its number of legs from eight to four in the interests of economy. However, it has retained the capacity to

suppress the tomato's jasmonic acid signaling pathway, which blocks the ability of the tomato host plant to produce defensive metabolites and proteins. However, the selective forces resulting in this genome diminution remain a puzzle—perhaps one is the poor nutritional value of tomato plants. —CA

eLife 9, e56689 (2020).



Tomato russet mites disable the immune responses of tomato plants.

WOUND REPAIR

Sensing and repairing epidermal injury

The skin protects underlying tissues and organs from potentially damaging microbes and other agents. Epithelial integrity must be reestablished after a skin injury that results in a surface break. For this to happen, cells use altered signaling and mechanical cues to trigger the repair process. Kennard and Theriot examined the mechanism of repair after injury to the zebrafish tailfin. By imaging the actin cytoskeleton, they noted different initial wound responses in zebrafish larvae in different environmental conditions. Cells are sensitive to external sodium chloride at the wound site, suggesting that a change in electrical potential is involved. Applying electric fields triggers actin polarization and basal cell migration, even in absence of wounding. Understanding how skin responds to osmotic and electrical changes may lead to methods for tissue repair. —BAP

eLife 9, e62386 (2020).

ATMOSPHERIC CHEMISTRY

HONO formation in the troposphere

Nitrous acid (HONO) is an important tropospheric intermediate. Current atmospheric models, which assume its formation in the heterogeneous reaction of nitrogen dioxide (NO_2) and water, fail to correctly predict the high concentrations of HONO that are detected in the troposphere. Using subnanosecond first-principles molecular dynamics simulations, Martins-Costa *et al.* show that HONO forms from NO_2 preferentially in bulk water with very low probability of its desorption from the surface of liquid water. The present results call into question the catalytic role of the air-water interface and suggest that further studies that take into account various tropospheric chemical species adsorbed on the aqueous droplets are required to elucidate the mechanism of this important atmospheric chemistry. —YS

J. Am. Chem. Soc. **142**, 20937 (2020).