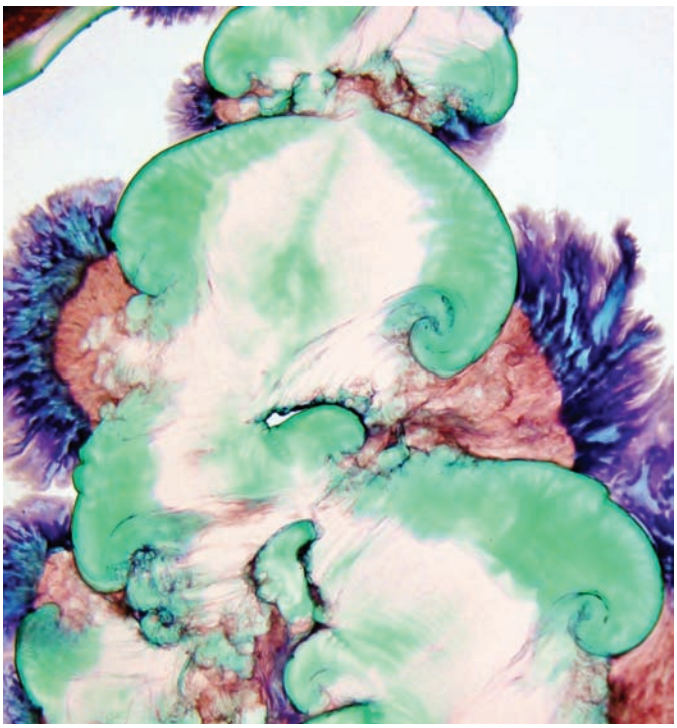
In This Issue

Chemical gardens in quasi-2D

When clumps of some solid metal salts are dropped into an anionic solution such as water glass, the salts tend to precipitate into a dazzling array of crystals with tendrils and offshoots that resemble a lush garden. Chemical gardens have long served as models for the development of self-organized materials such as fuel cells, catalysts, and parts of microfluidic devices, but a 3D analysis of their formation and properties has proved challenging, partly because osmosis, diffusion, and buoyancy influence garden growth. Florence Haudin et al. (pp. 17363–17367) grew chemical gardens in quasi-2D geometry using cobalt chloride, water glass, and a horizontal setup of acrylate plates called a Hele–Shaw cell, quantitatively analyzing the resulting patterns. By radially injecting different concentrations of one reactant into another at a fixed flow rate in a confined space, the authors produced a picturesque landscape of flowers, spirals, filaments, and terraces. The near-2D conditions diminished the effects of the physical forces normally active during garden growth and facilitated geometrical modeling of the precipitates; the authors report the results of modeling for one such pattern, namely spirals. According to the authors, this approach to growing chemical gardens might help improve the quantitative analysis of self-organized hierarchical structures such as cement nanotubes, corrosion filaments, and brine icicles at hydrothermal vents. — P.N.



Chemical gardens in confined geometry.

Factors tied to extreme Beijing haze

China has recently experienced severe increases in urban haze pollution due to fine particulate matter (PM), which has reached unprecedented levels in many of its cities. Researchers seek to better understand the mechanisms of PM formation, a critical public health threat, and devise mitigation strategies to reduce its regional and global impacts. Focusing on the nation's capital, Song Guo et al. (pp. 17373–17378) found that meteorological conditions in Beijing drive a periodic cycle of PM episodes characterized by two distinct processes of aerosol nucleation and growth. According to the authors, Beijing's meteorology, local and surrounding emissions, and aerosol processes combine to produce extremely polluted conditions, although the chemical composition of airborne particles in the city is similar to many other population centers worldwide. Volatile organic compounds, nitrogen oxides from urban transportation, and sulfur dioxide from regional industry contribute to large secondary PM formation, triggering a distinctive nucleation and continuous growth process that spans multiple days and produces numerous larger particles. According to the authors, regulatory controls over emissions are required to reduce urban PM pollution in China. — T.J.

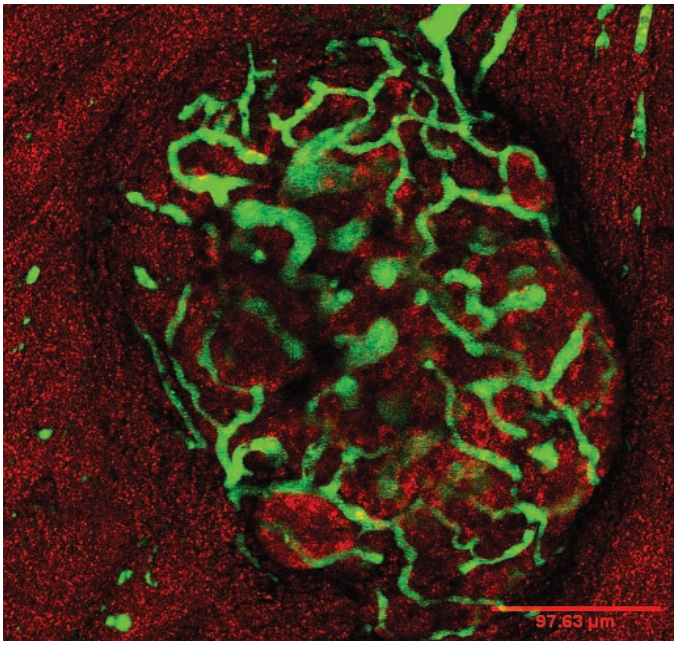
Campus view of Peking University on clean and polluted days.

Factors associated with bee decline

The decline in populations of both wild and managed bees has provoked concerns over the likelihood of a global pollination crisis. However, it remains unclear whether the loss of preferred host plants plays a key role in bee decline. Jeroen Scheper et al. (pp. 17552–17557) studied whether population trends of wild bees in the Netherlands could be explained by trends in host plants. The authors assessed host plant use by analyzing pollen loads on the bodies of bee specimens collected before 1950, including 57 bee species. The authors found that decline of preferred host plants was an important factor associated with bee decline. The other main factor associated with bee decline was bee body size, which was negatively related to population trend, likely because larger bees have a greater pollen requirement. Other factors, such as climate change sensitivity and diet breadth, were found to be comparatively less important in explaining recent bee population trends. Given the species-specific nature of wild bee decline, strategies to mitigate bee losses must target the specific host plants of declining bee species in order to be effective, according to the authors. — L.G.

Rejuvenating pancreatic islets

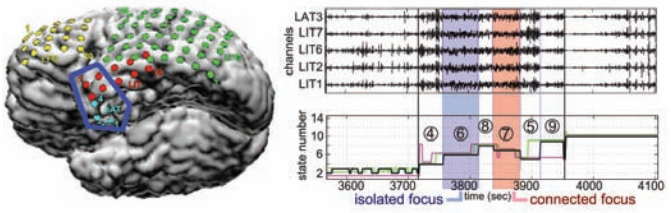
Pancreatic islets, responsible for secreting blood glucose-regulating hormones, decrease in function with age. Hypothesizing that this decrease in function may not be due to a decrease in glucose-sensing or hormone-secreting capacity, Joana Almaça et al. (pp. 17612–17617) measured the function of human and mouse islets of different ages. The authors found that age alone did not diminish islet glucose-sensing or insulin-secreting capacity and that aging islet cells experienced blood vessel inflammation and scarring that diminished vascular function. To determine how revascularization might affect islet function, the authors transplanted pancreatic islets from 18-month-old mice onto the irises of 2-month-old diabetic mice. The transplanted islets became revascularized with healthy blood vessel tissue, exhibiting strong islet cell proliferation, and regaining control of blood glucose levels within three months of transplantation. The results suggest that beta cells, the insulin-releasing cells in the pancreas, do not lose function with age. Increased demand for insulin over time, however, can place stress on the vascular system of pancreatic islets, which contain beta cells, leading to vascular inflammation, fibrosis, and loss of function. Treatment of age-related blood glucose dysregulation may benefit from a focus on reducing systemic or local inflammation to prevent vascular fibrosis, according to the authors. — P.G.



In vivo confocal image of a pancreatic islet (red) and blood vessels (green) 11 months after transplantation onto a mouse iris.

Brain connectivity and seizure onset

Around 40% of epilepsy patients cannot control seizures with medication and may be candidates for surgery. Prior to surgical resection, the patient's brain is mapped using intracranial electrodes that record changes in cerebral activity before, during, and after seizures, helping to pinpoint the seizure onset zone. Samuel Burns et al. (pp. E5321–E5330) used electrocorticographic (ECoG) recordings from such electrodes to identify patterns of activity in the brain network over several days with a 1-s resolution. In 12 patients undergoing a total of 42 seizures, with 40–119 brain regions covered per patient, the authors identified a finite and small set of brain states within each individual, with 2–5 states between seizures and 2–11 states during seizures. During a seizure, the brain progressed through a distinct set of states that was reproduced with every seizure in a patient-specific manner. Using the results of subsequent surgery to confirm the location of the seizure onset zone, the authors found that this zone demonstrates early abnormal ECoG activity, observed as a loss of synchronization with the other regions at seizure onset. This type of network analysis may help locate the seizure onset zone with high specificity and sensitivity prior to surgery, according to the authors. — C.B.



ECoG electrodes in an epilepsy patient (*Left*) and recordings from electrodes in the blue area at the time of seizure (*Top Right*).