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Paper mulberry and ancient Pacific migrations

Paper mulberry is a common East Asian tree that has been propagated across Oceania by humans since prehistoric times and used for making barkcloth, a culturally significant nonwoven fabric.

Paper mulberry inside Rano Kau, a volcanic crater on Easter Island.

Chi-Shan Chang et al. (pp. 13537–13542) sequenced chloroplast DNA from more than 600 paper mulberry samples from East Asia, Southeast Asia, and Oceania to trace the geographic origins of Oceanic paper mulberry trees, and, therefore, the origins of the Austronesian-speaking people who first brought the trees to Oceania. The authors identified 48 haplotypes, or sets of genetic variations that are inherited together, among the paper mulberry samples and reconstructed the relationships between these haplotypes. The haplotype most frequently observed in Oceanic samples appeared to be derived from a family of haplotypes that was otherwise exclusive to southern Taiwan. The distribution of haplotypes suggests a migration from southern Taiwan to Remote Oceania by way of New Guinea and the Indonesian island of Sulawesi. According to the authors, these findings are consistent with a Taiwanese origin for Austronesian peoples. Further, the authors found a strong haplotype similarity between North Taiwan and southeast China, suggesting a southeastern Chinese origin for the early settlers of Taiwan. — B.D.

Tuberculosis in the Inuit

The Nunavik region in Canada has a 50-fold higher incidence of tuberculosis (TB) than the Canadian average, as well as a limited genetic diversity of the TB-causing bacteria *Mycobacterium tuberculosis*. To explore bacterial genetic diversity in Nunavik, Robyn Lee et al. (pp. 13609–13614) analyzed whole-genome sequencing data from 163 *M. tuberculosis* isolates obtained over 23 years from 11 geographically isolated villages. The authors found that all isolates belonged to the Euro-American lineage of *M. tuberculosis*, and were tightly clustered into two sublineages, one consisting of 153 isolates and the other with 10 isolates. The authors estimate that TB was introduced into the region in the early 20th century, a period during which the Inuit interacted consistently with European traders. Since that time, *M. tuberculosis* has been transmitted extensively and mostly within villages, with villages often having one predominant strain and individual strains being mostly confined to one village. The authors found that the genomes of the *M. tuberculosis* isolates did not contain features of a hypervirulent strain. As a result, the authors suggest that the epidemiologic success of *M. tuberculosis* in Nunavik is primarily due to an environment conducive to TB transmission, and conclude that efforts to control *M. tuberculosis* in the region will thus require exploration of social factors that contribute to TB. — S.R.

Origins of dog domestication

Dogs are thought to have evolved from Eurasian gray wolves at least 15,000 years ago, but the precise time and location of dog domestication remain under debate. Most dogs are neither purebred nor mixed-breed, but instead belong to a geographically widespread and genetically diverse group called village dogs. Laura Shannon et al. (pp. 13639–13644) analyzed more than 185,800 genetic markers in the autosomes, Y chromosomes, and mitochondrial DNA of more than 4,800 purebred dogs of 165 breeds and more than 540 village dogs from 38 countries to uncover hints to the origin and spread of early dogs. The analysis, which revealed higher genetic

Village dog in Lamjura La, Nepal.

diversity in village dogs than purebreds, suggests that dogs were likely domesticated in central Asia, plausibly around modern-day Nepal and Mongolia. Whereas many populations in Egypt, Vietnam, and India—near the putative center of domestication—showed few signs of European admixture, village dogs in the South Pacific and Neotropics showed predominantly European origins. The authors suggest that domestic dogs may have originated in central Asia and spread to East Asia and beyond. According to the authors, genetic analysis of village dogs can supplement ancient DNA analysis in efforts aimed at uncovering the precise time and place of dog domestication and evolution. — P.N.

Submergence from committed sea levels

Sea-level rise is a consequence of climate change, although the precise amount of future sea-level rise in cities along US coasts is unknown and partially dependent on future actions regarding carbon emissions. Benjamin Strauss et al. (pp. 13508–13513) calculated the lands, municipalities, and populations in the United States at risk of long-term sea-level rise under scenarios of both unabated climate change and strong carbon emission cuts. The authors identified at-risk land that is home to more than 20 million people, including the majority in at least 21 cities with populations greater than 100,000 people. The authors suggest that contingent on global carbon policy and the stability of the West Antarctic Ice Sheet, more than half of the municipalities may avoid becoming mostly submerged, if carbon emissions are cut aggressively. Cities otherwise face so-called lock-in dates beyond which the cumulative effects of carbon emissions likely commit a city to long-term sea-level rise that could submerge the land under more than half of its population. Norfolk, Virginia, for example, faces a lock-in date of 2045 under a scenario of unabated carbon emissions. The results suggest that some municipalities may have to adapt or relocate in the face of future sea-level rise while others may avoid the risk of major inundation through changes in near-term carbon policy, according to the authors. — P.G.

Image courtesy of Wikimedia Commons/Joey Sheely.

Coastline of Norfolk, Virginia, in 2008.

Factors in timing of autumn dormancy

Shifts in plant phenology, or the timing of annual plant life events, in recent decades have been attributed to climate change. Events such as spring flowering are well-studied, but little is known about plant dormancy processes associated with autumn. Yingying Xie et al. (pp. 13585–13590) studied the timing of fall dormancy in New England forests between 2001 and 2012 through remotely sensed satellite data. The authors examined correlations between fall dormancy timing and cold, heat stress, frost, and wet conditions. Cold, frost, wet conditions, and high heat-stress were correlated with early autumn dormancy, whereas moderate heat and drought conditions were correlated with late autumn dormancy. Placing these findings in the context of climate change projections for the years 2041–2050 and 2090–2099, the authors suggest that future years may experience late dormancy in northern New England and early dormancy in coastal and southern New England, although frost and moisture patterns, as well as extreme weather events, may further affect dormancy timing. The results suggest that multiple environmental factors affect autumn phenology, and that interactions among the factors may influence forest dynamics as well as fall foliage ecotourism, according to the authors. — P.G.

Deciduous forest in Connecticut in autumn 2013.

Pure silicon from inexpensive alloy

Most modern electronic devices owe their existence to silicon, an abundant element whose material properties have enabled technologies such as microprocessors, solar cells, and fiber optic cables. Such applications, however, require varying degrees of highly purified silicon, currently produced by complex, expensive, and environmentally unsound processes. Linqi Zong et al. (pp. 13473–13477) describe a low-cost nanopurification process that yields 99.999% pure silicon from ferrosilicon, an inexpensive and widely available silicon–iron alloy. The process uses a high-energy ball mill to crush ferrosilicon pieces into nanoparticles. Because impurities in the ferrosilicon represent structural weak points, ball milling fractures the alloy at regions with impurities and exposes them to the surface. The impurities are then stripped away with an acid treatment, leaving behind purified silicon nanoparticles. As an example, the authors also demonstrate that silicon nanoparticles purified in this manner can be used as anodes in high-performance rechargeable lithium ion batteries. The findings represent a commercially viable and cost-effective procedure for recovering purified silicon from low-quality material, according to the authors. — T.J.