IN THIS ISSUE

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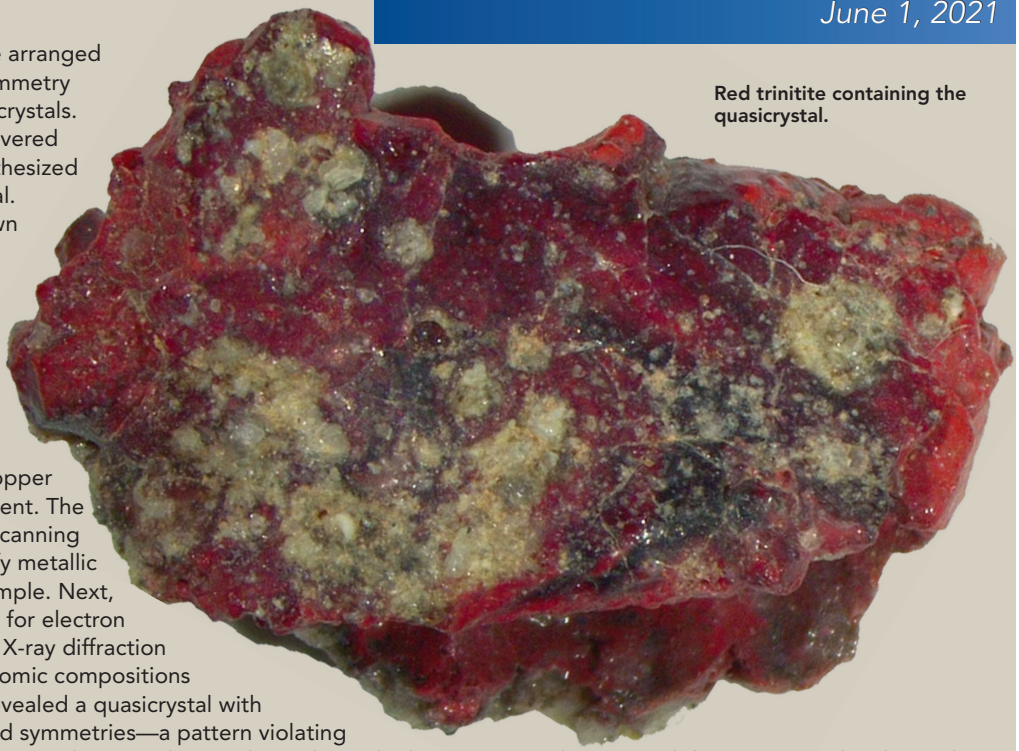
PHYSICS

Quasicrystal from first nuclear detonation



Red trinitite containing the quasicrystal.

The atoms of quasicrystals are arranged in patterns that violate the symmetry rules of ordinary, or periodic, crystals. Quasicrystals have been discovered in meteorite samples and synthesized in laboratories. Luca Bindi et al. identified a previously unknown icosahedral quasicrystal in a sample of red trinitite formed during the Trinity test, the first detonation of a nuclear bomb on July 16, 1945, at the Alamogordo Bombing Range in New Mexico. The trinitite was created when the detonation fused sand with copper wiring from recording equipment. The authors used back-scattered scanning electron microscopy to identify metallic blob candidates within the sample. Next, the authors isolated the blobs for electron microprobe and single-crystal X-ray diffraction analyses to determine their atomic compositions and structures. The analysis revealed a quasicrystal with fivefold, threefold, and twofold symmetries—a pattern violating the symmetry rules of periodic crystals. According to the authors, the historic event that created this quasicrystal makes it the oldest known extant anthropogenic quasicrystal, and its discovery suggests that other quasicrystals may form under similar thermodynamic conditions, such as lightning strikes, meteor impacts, or other nuclear detonations. — M.H.

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GENETICS

Gene editing suppresses fertility in *Aedes aegypti*

A male *A. aegypti* mosquito.

The sterile insect technique aims to reduce female insect fertility by inundating wild populations with sterile males. However, the technique has had limited success with *Aedes aegypti* mosquitoes, which spread dengue and other diseases, partly due to the use of sterility-inducing radiation, which mutates genes randomly and impairs the health of male mosquitoes. Jieyan Chen, Junjie Luo, et al. used CRISPR/Cas9 to generate a mutation that targets the testes and fertility of male *A. aegypti*. Examining a collection of genes that were previously identified in *Drosophila melanogaster* and are expressed in the testes of *A. aegypti* and implicated in male sterility, the authors homed in on the candidate gene *B2t*. The authors knocked out *B2t* using CRISPR/Cas9 and established gene-edited male mosquito lines. Single-pair matings between gene-edited males and virgin wild-type females yielded no progeny, and the seminal vesicles of the gene-edited males were devoid of sperm. Results from cage assays suggested that exposure to 15 gene-edited males reduced female fertility to 2.6 ± 1.6%, even if the females later copulated with wild-type males. Preexposure to an average of 5.6 gene-edited males reduced female fertility by 50%. According to the authors, the introduced mutation allows the mutant males to compete with wild-type males and reduce female fertility. — M.H.

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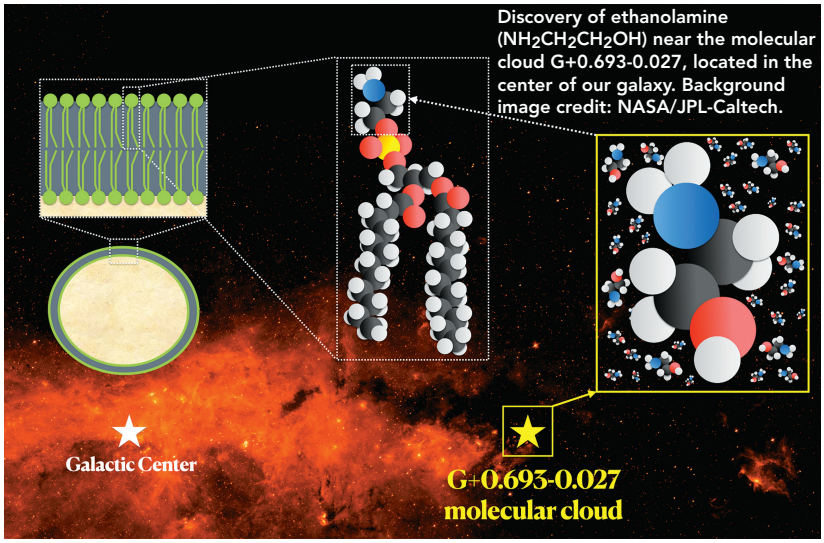
ASTRONOMY

Prebiotic ethanolamine found in space



Discovery of ethanolamine ($NH_2CH_2CH_2OH$) near the molecular cloud G+0.693-0.027, located in the center of our galaxy. Background image credit: NASA/JPL-Caltech.

The formation of cellular membranes represents a significant step in the evolution of life on Earth, given that membranes composed of phospholipids help keep cellular genetic material and metabolic machinery together. The origin of the cellular membrane, however, is unclear. Víctor Rivilla et al. detected the presence of ethanolamine, a component of the head of phospholipids, in a molecular cloud near the center of our galaxy using the IRAM and Yebes radiotelescopes. Ethanolamine, which forms the hydrophilic head of phospholipids, had been previously detected in meteorites, but the abundance of the molecule in space relative to water reveals that the molecule likely formed in space and was later incorporated into meteorites. The authors suggest that ethanolamine may also have been incorporated into planetesimals and other minor bodies of the Solar System, including precursors to Earth. Experiments simulating the chemical conditions of early Earth confirmed that ethanolamine could have formed phospholipids under such conditions. According to the authors, the availability of ethanolamine on early Earth, together with amphiphilic fatty acids or alcohols, may have contributed to the assembly and early evolution of primitive cell membranes. — P.G.

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EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

Upslope advance of forest fires

Fire is integral to the maintenance of forests. However, in recent decades, fire size, the length of fire seasons, and the number of fires have increased in the western United States. Forest fires have also advanced upslope, extending the fire territory to previously wet areas. Mohammad Reza Alizadeh et al. examined records of forest fires larger than 405 hectares that occurred between 1984 and 2017 across 15 mountainous ecoregions of the western United States. Since 1984, high-elevation fires have advanced upslope by 252 meters. Upslope advance was greater for high-elevation fires than for fires at low elevations. The extent of burned area also increased at a greater rate at high elevations—where fire and anthropogenic activity have been historically rare—than at dry, low elevations colocalized with human settlements. The primary cause of high-elevation fires was lightning, whereas low-elevation fires mainly resulted from anthropogenic activity. The authors also found a significant relationship between high-elevation fires and increased aridity during warm seasons. Global warming has reduced the high-elevation flammability barrier, making an additional 81,500 square kilometers of forested land across the western United States susceptible to fires. The findings suggest that climate change largely contributed to increased fire activity in the United States, according to the authors. — M.S.

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Noisy Creek Fire of 2017, with Washington's Colville National Forest aflame. Image credit: Flickr/National Interagency Fire Center.

JOURNAL CLUB

Highlighting recent, timely papers selected by Academy member labs

June 1, 2021

Transcription factors bind different regions of the corn genome in predictable patterns across cell types. Image credit: Shutterstock/ Thanaphong Araveeporn.

GENETICS

Atlas identifies genome regions that regulate plant cell identity

Posted on May 21, 2021

Amy McDermott

Zoom in on the leaf of a corn plant, and you'll find a patchwork of about 20 different cell types. A recent study, published in *Cell*, provides an atlas of critical genomic regions that control cell identity in six different corn organs, and perhaps the organs of other plant species.

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