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CHEMISTRY

Pigment analysis allows detailed study of ancient artwork

By refining an established measurement technique to analyze microscopic samples of natural organic pigments and glazes from ancient art, Marco Leona has uncovered the earliest known example of a historically important dye. Researchers can use historical records of organic pigments made from plants and other natural materials to follow ancient trade routes, identify relationships between various works of art, detect forgeries, and place artwork in historical context. Previous techniques have not been sensitive enough to detect the miniscule samples of organic pigments found on most archeological objects. Leona improved a technique called surface-enhanced resonance Raman scattering (SERS) by developing a procedure that maximized dye absorption on the silver nanoparticles used in the analysis. Leona used this method to detect the earliest known example of the dye, madder lake, in a 4,000-year-old Egyptian object. The author also discovered the earliest known occurrence in Europe of a dye from South Asia made from insects in a 12th century French sculpture. The sensitivity of this technique could enhance scientific studies of art by allowing more efficient analysis of organic pigments from samples smaller than 25 μm in diameter compared to existing methods, Leona asserts. — B.A.

Fragment of a quiver found in Thebes, Upper Egypt.

"Microanalysis of organic pigments and glazes in polychrome works of art by surface-enhanced resonance Raman scattering," by Marco Leona (see pages 14757–14762)

AGRICULTURAL SCIENCES

RNA may help explain honey bee collapse

Since 2006, honey bees in the United States have experienced catastrophic losses from colony collapse disorder (CCD). Studies have linked CCD with pesticides or picorna-like viruses, such as deformed wing virus and Israeli acute paralysis, but none have pinpointed a direct cause. Reed Johnson et al. used whole-genome microarrays to analyze gene expression in the honey bee gut, which is the primary site of bee pesticide detoxification and immune defense. The authors compared bees from CCD colonies on the east and west coasts of the United States with bees from healthy hives and found that gene expression varied depending on where the bees lived. CCD bees had an abundance of unusual ribosomal RNA fragments, suggesting that protein production had been compromised. Such fragments could result from multiple infections with viruses associated with CCD, the authors say. Even if the root cause of the unusual honey bee disappearance is not viral overload, testing for ribosomal fragments could be a useful diagnostic marker for CCD, according to the authors. — B.A.

Honey bee collects pollen from a flower.

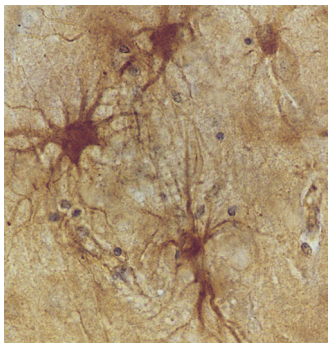
*"Changes in transcript abundance relating to colony collapse disorder in honey bees (*Apis mellifera*)" by Reed M. Johnson, Jay D. Evans, Gene E. Robinson, and May R. Berenbaum* (see pages 14790–14795)

BIOCHEMISTRY

Mental retardation linked to mutations in the *HSD17B10* gene

Mental retardation has been linked to mutations in the hydroxysteroid dehydrogenase 10 (*HSD17B10*) gene, which is expressed throughout the brain. The gene produces a multitasking enzyme that processes many neurosteroids, including allopregnanolone, estradiol, and also controls the degradation of isoleucine. But researchers have not established how or why *HSD17B10* is required for normal brain development. Song-Yu Yang et al. propose that different missense genetic mutations likely cripple the enzyme's ability to catalyze the reactions involving specific steroids while leaving some of its other functions intact. This, the authors propose, can lead to an imbalance in neurosteroid levels that may lead to neurological

deficits. Using a sample from a mentally retarded male patient, the authors discovered a missense mutation in *HSD17B10* that produced a single amino acid substitution that slowed the activity of the enzyme. The authors describe another mutation from a deceased 10-year-old boy that destroyed all of the enzyme's functions. Appropriate *HSD17B10* levels are critical for normal brain development because of the many functions the enzyme serves, according to the authors. — B.P.T.



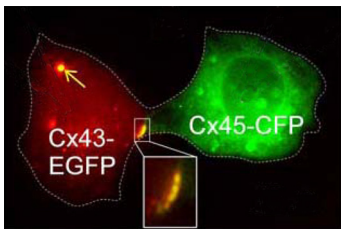
HSD17B10 accumulated in a Down's syndrome brain.

"Mental retardation linked to mutations in the HSD17B10 *gene interfering with neurosteroid and isoleucine metabolism" by Song-Yu Yang, Xue-Ying He, Simon E. Olpin, Vernon R. Sutton, Joe McMenamin, Manfred Philipp, Robert B. Denman, and Mazhar Malik* (see pages 14820–14824)

BIOPHYSICS AND COMPUTATIONAL BIOLOGY

Intercellular channels act as directional valves

Connexin proteins form cell-to-cell channels, called gap junctions, which allow molecules to pass directly from the interior of one cell to another and also serve as a physical substrate for electrical and metabolic intercellular signalling. Nicolas Palacios-Prado and Feliksas Bukauskas found that gap junctions formed between cells that express different connexin proteins can exhibit asymmetric electrical cell-to-cell signalling and metabolic communication. The authors found that small differences in the membrane potentials of communicating cells or action potential-like stimulation can block or substantially enhance dye transfer between cells; the heterotypic junctions essentially acted as voltage-sensitive valves and demonstrated the involvement of voltage gating in the metabolic communication of nonexcitable cells. Hypoxia, ischemia, and other pathological conditions have been shown to alter the resting and action potentials of cells, and these pathologies may affect electrical and metabolic signalling between communicating cells. The study may help researchers understand the underlying mechanisms of disorders such as stroke, cardiac arrhythmias, and other diseases in which intercellular communication is thought to play a role, according to the authors. — F.A.



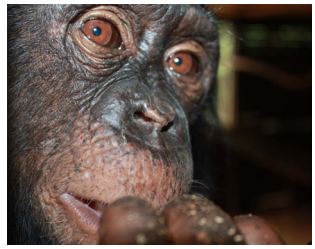
Cell pair exhibiting a heterotypic junctional plaque.

"Heterotypic gap junction channels as voltage-sensitive valves for intercellular signaling," by Nicolas Palacios-Prado and Feliksas F. Bukauskas (see pages 14855–14860)

EVOLUTION

The origin of malaria

The origin of malaria, one of the deadliest human diseases, were hitherto unclear. Stephen Rich et al. identified a transmission route that they suggest may be the original source of malaria. The authors report that the disease likely originated from a parasite that moved from chimpanzees in equatorial Africa to humans via mosquitoes. Although chimpanzees were known to harbor a parasite, *Plasmodium reichenowi*, that is closely related to the dominant human malaria parasite, *Plasmodium falciparum*, most researchers assumed that these parasites had coexisted separately in human and chimpanzee ancestors for the last 5 million years. The authors sampled wild and wild-born captive chimpanzees in Cameroon and Ivory Coast during routine health exams in three wildlife sanctuaries and identified several previously unidentified parasites from the chimpanzees. The findings indicate that malaria jumped from animals to humans, similar to the origin of diseases such as HIV, SARS, and swine flu. Discovery of these parasites shows a broad range of relatives to the human parasite, some of which might provide insight in drug development or in vaccines that may help prevent human malaria, according to the authors. — J.L.



Chimpanzee in the Mfou National Park in Cameroon. Image courtesy of Matthew LeBreton, Global Viral Forecasting Initiative.

"The origin of malignant malaria," by Stephen M. Rich, Fabian H. Leendertz, Guang Xu, Matthew LeBreton, Cyrille F. Djoko, Makoah N. Aminake, Eric E. Takang, Joseph L. D. Diffo, Brian L. Pike, Benjamin M. Rosenthal, Pierre Formenty, Christophe Boesch, Francisco J. Ayala, and Nathan D. Wolfe (see pages 14902–14907)