World Science News In Review

[Archeology/Biology]

Recent Research Suggests Neanderthals Not Our Ancestors

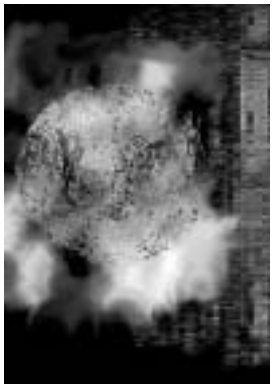
Based on a recent joint Italian-Spanish study of mitochondrial DNA (mtDNA), the Neanderthals might not be our ancestors as many scholars had previously thought. For ages researchers have been trying to solve the mystery of early human origin. The Replacement Model suggests that the early modern humans (e.g., Cro-Magnon) left Africa and replaced the Neanderthals in the European regions, while the Multi-Regional Theory argues that the two populations not only coexisted, but also interbred. The latter theory suggests that our genes should reflect an ancestry of both species, a scenario not supported by the most recent research. Scientists recently found reasonable resemblance between modern humans and the Cro-Magnon. The study, however, only investigated the mitochondrial DNA (mtDNA), the one kind of DNA currently available. MtDNA is passed down to offspring by the mother; therefore it is not perfectly certain that Cro-Magnon did not interbreed with Neanderthals—an argument that Multi-Regional proponents support. The major qualm people have with the Replacement Model is that it suggests modern humans are more related to a species that lived 45,000 years ago than a species that lived 20,000 years ago. The solution to the mystery may not be elucidated in the near future because analysis of nuclear DNA from ancient samples is not currently feasible. Scientists, however, hope that the advance in human genome mapping will provide other pieces of the puzzle.

—W. V. Lee

[Biology]

New Discovery in Early Prostate Cancer Detection

The diagnosis of prostate cancer has always been tricky; its treatment is even more so. Over treatment can lead to unnecessary suffering from the side effects, while under treatment can pose mortal danger. Over the years, several predictive markers have been developed to aid in accurate diagnosis and therefore adequate and effective treatment. Among the first markers are prostate-specific antigen (PSA) concentration in blood, Gleason score (which measures the tumor's grade), and the tumor's stage, which is determined by its size. Kattan nomograms, a popular set of algorithms used to predict the probability that a given therapy will cure a patient's cancer, can combine the three markers. It was widely used in the 90s and could predict up to 80 percent accuracy. Next came gene-expression profiling, a technique that utilizes DNA microarrays to determine a cell's potential to become cancerous. Although this marker has worked well with other cancer types, it has not been very helpful in prostate cancer diagnosis until now. Mark A. Rubin and his team at Harvard University have recently identified a gene for the protein EZH2, whose presence is a likely sign of prostate cancer metastasis. Another research team, led by William L. Gerald, has been able to design a new combination of markers that includes the old indicators as well as the newly discovered EZH2. This combined method was able to predict up to 90 percent accuracy of the metastasis potential within four years of prostate removal surgery. At the same time, other studies of non gene-related diagnostic markers are also underway. Magnetic resonance imaging (MRI) is one. Ralph Weissleder of MGH and his colleagues found that micro-magnetic-particle injection can effectively increase MRI's precision and thus accurately and non-invasively show whether the cancer has metastasized or not. Scientists hope to collaborate and draw from all aspects of the existing markers to develop the best method for diagnosis.



Orange staining marks the presence of the protein EZH2 in prostate cancer cells on the left of this composite image. Red squares on the DNA microarray at right identify genes that are active in metastatic prostate cancer. Green squares indicate genes that are repressed.

—W. V. Lee

Scientists Recognized Gene Responsible for Dyslexia

Dyslexia, a learning disorder that causes difficulties in written and oral expression, affects at least one in 25 people. Although the cause is unknown, scientists have recently identified a gene that might be responsible for the disease. Geneticist Juha Kere of the Karolinska Institute in Huddinge, Sweden, and his team have pinpointed a gene named DYXC1 on chromosome 15 as one of the culprits for the disorder. He explained that disruption of the gene would result in blocked or altered production of a certain protein that only specific brain cells can respond to. Furthermore, Kere has found that the molecular makeup of this protein is significantly different from its analog in apes. The discrepancies might be a key to the evolution of *Homo sapiens*. Meanwhile, another team led by geneticist Shelley D. Smith of the University of Nebraska Medical Center is investigating another gene on chromosome 6 that might play a role in causing dyslexia. Further research is required to find out if DYXC1 is linked to other developmental disorders.

—W.V. Lee

Another Study Confirms Pregnant Women Must Use Common Sense

The stability of the period between conception and early embryonic development is integral for the healthy growth of a newborn. The smallest aberration during this period has the potential to cause a miscarriage. A new study reports that pain-killing medications such as aspirin, ibuprofen, and others, taken during this fragile period, may increase the likelihood of a miscarriage.

Performed by the Kaiser Foundation Research Institute in Oakland, California, the study sampled 1,055 women who had just received a positive pregnancy test result. Fifty-three of these women reported using NSAIDS (the heading under which nonsteroidal anti-inflamma-

tory drugs are classified) other than aspirin. Of those 53, 13 women experienced a miscarriage. This represents an 80 percent increase in likelihood, as compared to the 762 women who had not used any NSAIDS at all. The 22 women who reported using aspirin were 60 percent more likely to experience a miscarriage. On the other hand, the 172 women who took acetaminophen (Tylenol,) a pain-killing medication not classified under NSAIDS, did not experience increased risk of miscarriage.

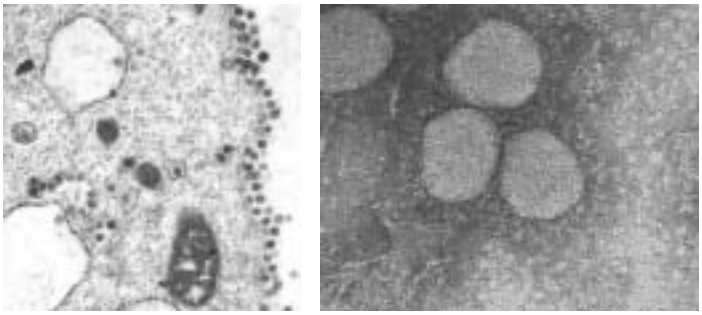
NSAIDS alleviate pain by interfering with cyclooxygenase, an enzyme that leads to the production of lipids known as prostaglandins. Prostaglandins are responsible for pain and inflammation, among other functions such as aiding in smooth-muscle contraction, and thus their suppression fulfills the intended purposes of NSAIDS. Postaglandins are synthesized by the uterine lining during implantation and emerge to play an integral role in monitoring and maintaining healthy embryonic functions. Their absence may provide the direct link between NSAIDS and miscarriage.

Criticism has been reported, notably from Nick Henderson, director general of the International Ibuprofen Foundation in Marborough, England. He has been quoted in labeling this study as "alarmist." Scientists do warn women that this study is, in fact, small and may not provide a definitive conclusion. Further studies must be investigated to draw a direct link between NSAIDS and miscarriages. Yet the fact remains that women must be careful and cautious during pregnancy, limiting the amount of medications and risk factors they expose themselves to. —E. Slutsky

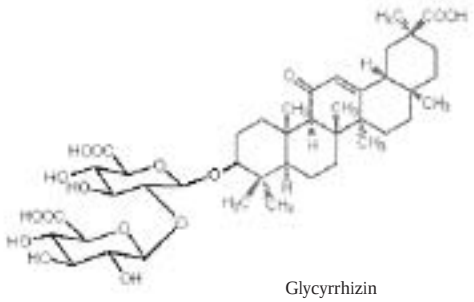
[Chemistry]

Licorice Compound Might Swallow SARS Threat

Glycyrrhizin, an antiviral agent isolated from licorice root, could become the most effective defense against severe acute respiratory syndrome (SARS). SARS is a highly contagious disease that broke out in the Far East early this year, and then was inadvertently introduced to North America by several carriers.



The SARS coronavirus emerged in November 2002 and killed hundreds before being contained, but new drugs are needed in case it re-emerges.

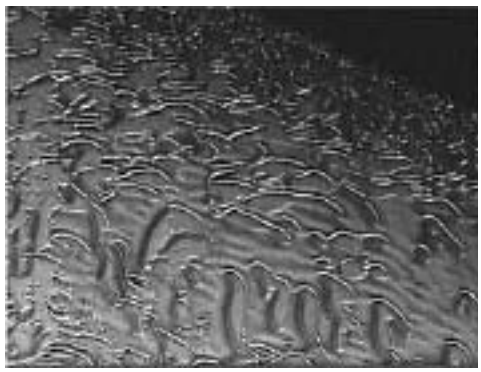


Glycyrrhizin

Jindrich Cinatl and colleagues at the Frankfurt University Medical School, Germany, tested the antiviral properties of five drugs (ribavarin, 6-azauridine, pyrazofurin, mycophenolic acid, and glycyrrhizin) against the SARS coronavirus. Each compound has previously been used for its antiviral, antitumor, or immunosuppressive properties. Ribavirin is currently most often used to treat SARS infection. Effective against unrelated HIV-1 and hepatitis C infection, glycyrrhizin has been proved to be effective in inhibiting viral replication. It probably increases nitrous oxide synthesis, and it is known to affect cellular signaling pathways like protein kinase C, casein kinase II, and various transcription factors. —I. Lim

Liquid Crystals Improve

Researchers have created a new class of liquid crystals that selectively reflect light, a breakthrough that could improve the quality of future optical devices. The new crystals are stable at high temperatures and have a low melting point, a temperature versatility that materials developed earlier lack.



The texture of a liquid crystal chiral nematic phase

British chemists John Goodby and Isabel Saez had concentrated their research on dendrimers, large molecular structures with useful properties but incapable of functioning independently. However, when they modified the dendrimers to generate a hybrid organic-inorganic system, Goodby and Saez were able to incorporate the dendrimers into huge fabricated crystals made of buckyballs. "We could put a chemical unit that had a functional property into a giant liquid crystal and have it self-organize," said Goodby. "This is effectively what proteins do, but we were doing it in an advanced materials sense!"

The similarity with proteins raises the possibility of synthesizing "materials with protein-like properties," akin to a "molecular machine," with implications as yet unknown. The new materials could more immediately be applied to improve optical filters, digital watches, and coatings for transparent surfaces, all current common uses of liquid crystals. —D. Barclay

[Earth, Atmospheric, and Planetary Sciences]

New Correlation Buttresses Dark Energy Theory

The correlation of galaxy locations and cosmic background radiation is a contribution to the growing body of evidence supporting the theory of dark energy, according to new work reported in the August 2, 2003 issue of *Science News*.

Advocates of the dark energy theory attribute the acceleration of the expansion of the universe to the mysterious substance heretofore called dark energy.

Cosmic background radiation is remnant radiation from the Big Bang.

Four independent studies from the Wilkinson Microwave Anisotropy Probe (WMAP) correlated with maps of galaxy locations. All four studies show a relative blue-shift, indicating a higher energy, in cosmic background radiation emerging from regions of high-matter concentration, such as galaxy superclusters, when compared to cosmic background radiation emerging from regions of lower-matter concentration. Hence, the studies show a positive correlation between matter concentration and the apparent energy of cosmic background radiation.

The energy gained by photons entering a region of matter should equal the energy lost by photons leaving the region, resulting in zero increase in energy. However, the studies observed a slight increase in energy. According to the analysis in the studies, dark energy pushes matter apart during the period when photons traverse the matter so that the photons expend less energy as they leave the matter. The difference in energy is the observed energy increase, according to the studies.

The four studies were conducted by: R. Scranton et al. of the University of Pittsburgh; P. Fosalba et al. of the Institut d'Astrophysique de Paris; S. Boughn of Haverford College, and R. Crittenden of the Institute of Cosmology and Gravitation in Portsmouth, England; and M. Nolta of Princeton University. —J. Wong

[EECS]

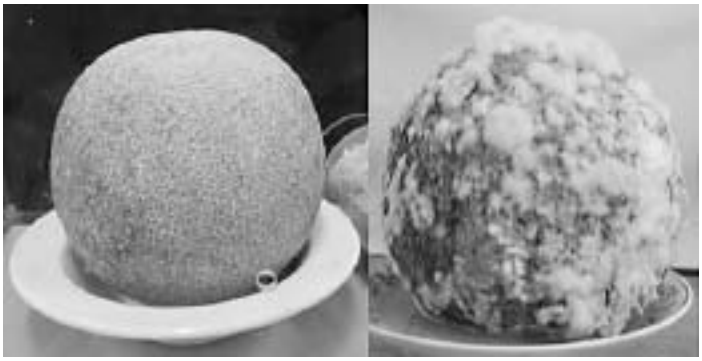
Hopping for Bandwidth: Rooftop Networking

Do you ever dream about surfing the Internet from anywhere in the world? Researchers from the MIT Roofnet project are trying to make that dream come true. With the help of a whole lot of rooftop antennas, computer science professor and project leader Robert Morris and his students are building a network of computers equipped with Wi-Fi cards to efficiently route data packets. At the expense of a fireplace, users of the Roofnet can get Internet access equivalent to broadband cable, with no monthly payments to an Internet provider. Antennas are mounted to the rooftops so that data packets can hop from one roof to the next until they finally reach a computer that is connected to the fixed Internet in the MIT computer science building. This multihop mesh network technology has drawn interest from research groups at Carnegie Mellon, Rice, and UCLA, and companies such as Nokia, Intel, and Microsoft. Community mesh networks like Roofnet are believed to be a promising way of bringing wireless networking to a majority of the population, especially people in rural areas where wired broadband access is not feasible. Roofnet is different from regular community-owned wireless networks because its nodes are not permanently connected to the network. Instead, the network constantly checks existing links and forms new ones, thus making the network more dynamic. This technology still has to overcome some practical issues. Unpredictable weather conditions and environmental disruptions can severely degrade the packet signals. MIT researchers are currently debugging and fine-tuning their routing schemes in hopes of utilizing them in more complicated systems such as using car antennas becoming mobile nodes. —H. Wang

[Materials Science]

Layered Assembly on the Rise

Rapid advances in a materials construction technique have opened the door to its possible commercialization in the near future. The technique, which progressively adds nanoscale coatings to surfaces, allows for a greater degree of control over the material' s properties than traditional methods.



Fruit Fuzz. Melons protected with Yasa-sheet (left) don't rot as quickly as those left to fend for themselves (right).

"This field is reaching the point where we're really starting to harvest some very interesting new technologies based on these materials," said Michael Rubner of MIT. "This is going to be a very exciting time in the next few years and beyond." Researchers are trying to use layered assembly techniques to improve everything from solar cells, aviation equipment, and body armor to artificial bone, biomedical devices, and fruit preservation.

Experimentation is facilitated by the procedure's technical accessibility. Dipping a negatively charged solid surface into a positively charged solution and letting it dry yields one layer of coating. That leaves only the need to repeat the process numerous times, which can be done by robots. Louisiana Tech University researcher Yuri Lvov characterized the method as "very simple, even primitive."

This simplicity appeals to numerous small start-ups such as Strala Materials, Capsulution, and Shiratori NanoTechnology, which believe that the layering technique can be mass-produced cheaply. Larger businesses such as CibaVision have also exhibited interest in building an industry around the emerging technology. Profits as yet remain elusive, but interest in the field is certainly not. —D. Barclay

[Math and Biology]

Cellular Circuits

Researchers are developing cellular computer programs, organic circuits dependent on genetic material. "We're basically hacking DNA instead of software," said Ron Weiss of Princeton University.

Certain genes instruct a cell to produce one type of protein if another type of protein is present. By organizing the cells into chains and altering their genetic instructions, digital logic gates can be created. For example, if protein A inhibits a cell from forming protein B, a primitive inverter results. Biological AND gates can also be built (by using the inverter on DNA, of course), so theoretically any type of circuit is possible.

Weiss's group has designed a five-gene circuit in E. coli bacteria that generates fluorescent proteins whenever the concentration of a surrounding chemical falls within a certain level. This could assist environmental engineers in detecting toxins. If slight variations of the circuit were made to respond to different conditions, the resulting protein patterns could even form a topographical map of toxin concentration.

However, researchers are hindered by the time-consuming work of programming the cells in the first place. Each genetic modification requires a lengthy procedure using enzymes to cut out the relevant sections of DNA, reorder them, and insert them into the target organism. Linking two cells in a circuit requires that a number of factors be closely synchronized, so even a small amount of error can cause the procedure to fail.

To get around this problem, much genetic-circuit engineering work revolves around computer modeling to simulate conditions before they occur. Although those computers currently use inorganic circuits, in the future, it's anyone's guess. —D. Barclay

[Neuroscience]

Enzyme Disrupts Tau Tangles

Researchers have reported that an enzyme known as Pin1 prevents aging mice from developing protein knots in their neurons. These knots, caused by the tau protein, are frequently found within the neurons of patients with Alzheimer's disease. It is believed that Pin1 could lead to new treatments for the disease.

The study was conducted by Kun Ping Lu of the Beth Israel Deaconess Medical Center in Boston, Tony Hunter of the Salk Institute for Biological Studies in La Jolla, California, as well as their colleagues, and was published in the July 31 issue of *Nature*. Lu and Hunter were the original discoverers of Pin1 in 1995, showing that the enzyme interacts with the tau protein, which is normally a critical component of the internal skeleton of a cell. However, in Alzheimer's disease, molecular tags known as phosphates bind with tau, forming protein tangles within neurons.

In 1995, Lu and Hunter discovered that Pin1 binds with the tagged tau proteins, causing the phosphates to be released. The recent study showed that mice with an inactive Pin1 gene experience neuron loss as they age. Examining the brains of the mice, Lu and Hunter discovered that within the areas affected by neurodegeneration, tau proteins are tagged with phosphates, forming tangles within the neurons.

The researchers also studied the preserved brain tissue of Alzheimer's patients, noting that the lowest percentage of neurons with tangles was found in regions with the highest concentration of the Pin1 enzyme. —M. Burns