who carried recently evolved forms of the genes tended to speak nontonal languages, with the newer versions of *ASPM* and *Microcephalin* appearing roughly 5,800 and 37,000 years ago, respectively. Prior studies showed that these mutations apparently do not affect intelligence, brain size or sociability. Ladd and Dediu instead suggest in the June 26 *Proceedings of the National Academy of Sciences USA* that these mutations lead to subtle differences in the cerebral cortex related to language and tone.

Ladd emphasized that there are no "genes for Chinese." As he explains it: "If you raised a boy from China in Kansas, you wouldn't find him speaking Chinese, and vice versa." Still, people might take slightly different routes to learning certain languages because of their genes. "It may even be that some find it easier to acquire tone languages than others," he adds.

Others argue that no genetic predisposition for tone languages exists. Perceptual and cognitive psychologist Diana Deutsch of the University of California, San Diego, has found that speakers of tone languages are more likely to have perfect pitch—the ability to identify any pitch heard without hearing a reference note. Her work also hints that perfect pitch is not rooted in genes—and, by extension, tone languages are not, either. Deutsch adds that the apparent link Ladd and Dediu saw "could just be a coincidence" that further research would undo, something Ladd agrees with.

Still, although perfect pitch and tone languages appear linked, "that doesn't mean that perfect pitch is necessary for tone languages," remarks Northwestern University neuroscientist Patrick Wong. Instead he suggests that if *ASPM* and *Microcephalin* do play a role with tone languages, the genes might help in hearing high and low pitches, incorporating high or low pitch into words and sentences or tracking patterns in changes of pitch. Wong finds Ladd and Dediu's work "very interesting" but "inconclusive."

BUT DOES IT SOUND RIGHT? A study concludes that a genetic predisposition may exist for tone languages, such as Chinese, over non-tone tongues, such as English.

RANDY FARIS *Corbis*

Ladd notes that future studies could focus on people as they seek to learn new tone languages and see whether any mutations of *ASPM* and *Microcephalin* are linked with their level of success. Still, he thinks that even if the genes do play a role in tone and language, "these could be very subtle effects that simply do not get noticed against a background of other factors related to a person's upbringing."

Charles Q. Choi is a frequent contributor.

SECURITY

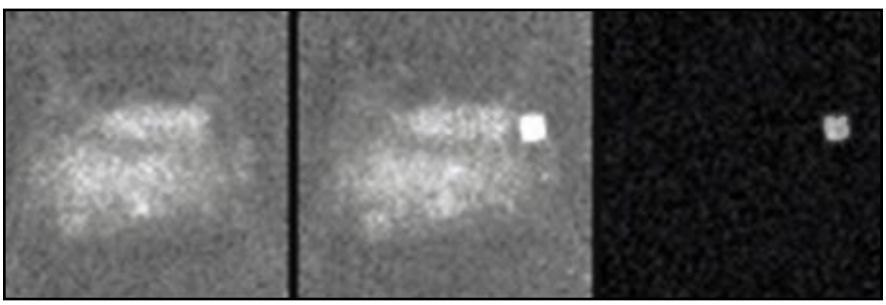
Muons for Peace

New way to spot hidden nukes gets ready to debut BY MARK WOLVERTON

The same place that gave the world the atomic bomb has now found a way to ferret out illicit nuclear material. Los Alamos National Laboratory has developed a method to search for heavy elements such as uranium via subatomic particles from space called muons. By 2008, "muon tomography" might be guarding U.S. borders.

About 10,000 muons reach every square meter of the earth's surface a minute; these charged particles form as by-products of cosmic rays colliding with molecules in the upper atmosphere. Traveling at relativistic speeds, muons can penetrate tens of meters into rocks and other matter before attenuating as a result of absorption or deflection by other atoms. The scattering is most pronounced in dense substances such as uranium and plutonium—elements with high Z (the number of protons in an atom's nucleus). "We use the fact that the scattering is sensitive to Z and particularly sensitive to the materials that you build nuclear bombs from or that you shield nuclear bombs with," explains Los Alamos's Christopher Morris, chief creator of the technology. "We measure the scattering angle for every muon, we measure the angle on the way in and the angle on the way out, and the change in the angle tells you how much material you've gone through."

After 9/11 heightened security concerns, Morris and his team realized that



MUON VISION: An automobile engine (*left*) is imaged based on the muons that pass through it. The scan reveals a lead cube hidden inside the engine (*center*). The lead becomes plainly visible when the muon data for the engine are subtracted (*right*).

CHRISTOPHER MORRIS *Los Alamos National Laboratory*

Subatomic Help for Subterranean Threat

Physicist Luis Alvarez was the first to use muons to peer inside objects, as he searched for hidden chambers inside one of the Giza pyramids in the 1960s. He did not find any, but his work proved the viability of muon radiography. Besides guarding against terrorism, muons could warn of natural threats. Hiroyuki Tanaka of the University of Tokyo and Toshiyuki Nakano of Nagoya University in Japan have used special photographic plates to collect muons passing through Japan's volcanic Mount Asamayama. Changes in the number and direction of muons provided images of the volcano's interior and the movement of magma within, raising the possibility that the technique could predict imminent eruptions.

STEVE KAUFMAN *Corbis*

muons could provide a way to detect smuggled nuclear materials better than existing x-ray, neutron, or gamma probes, which can expose people to stray radiation. That is not a problem with muon scanning, because muons are already naturally present. And whereas shielding can defeat other scans, it only makes nuclear contraband easier to find with muons: the dense shielding stands out prominently with muon tomography, which lacks the background scatter that blurs x-ray images.

A prototype muon tracker, completed in 2006, successfully sniffed out test objects such as a 10-centimeter cube of lead hidden inside an engine block, something that would have evaded a conventional x-ray scan. "It gave us the confidence that this technology would definitely work and that we were ready to move on to the next stage of development," says Erica Sullivan, Los Alamos's technology transfer liaison.

Decision Sciences Corporation, a San Diego–based software company specializing in defense applications, discovered the Los Alamos work and became even more enthusiastic on learning that muon tomography could also spot medium-Z bomb-making ingredients, such as iron and copper, which are used in improvised explosive devices. That led to a formal agreement this past spring between Los Alamos and Decision Sciences to develop a commercial muon tomography system for homeland security use.

The partnership is now busy constructing an operational prototype. "This is no longer laboratory simulation or physics simulation or small scale, this is now the real thing in real size," says Dave Klugh, Decision Science's manager for the effort. A commercial version of the scanner, dubbed Guardian MT, is expected by 2008.

Unlike the lab-size prototype, the commercial muon tomography scanner will be a tunnel big enough to drive a semitrailer truck through. Layers of aluminum detector tubes will enclose a volume of about 16 feet high by 12 to 14 feet wide, for about a length of 60 feet. Each gas-filled tube will have a thin wire running down its middle to detect muons by the telltale ionization trails left when they have passed through. Scanning times for detailed, tomographic pictures can vary from 20 seconds up to a minute, depending on the size and loading of the vehicle. As the system "learns" the configuration of various vehicle makes and models, it can ignore known innocuous data such as the engine and transmission, cutting down the scanning time—and making anything unusual stand out even more.

Donald Geesaman, senior physicist and acting associate director of the phys-

ics division at Argonne National Laboratory, calls the Los Alamos project "very intriguing." He notes that the team members "have made significant progress in the difficult problem of obtaining sufficient imaging resolution for this purpose."

With major funding now coming from Decision Sciences, the developers are confident that by next year, muon tomography will be up and running. As Klugh sees it: "There is a definite need for this type of product, and the need existed yesterday."

Mark Wolverton writes about science and technology from Bryn Mawr, Pa.

NERVE REGENERATION

Healing Broken Nerves

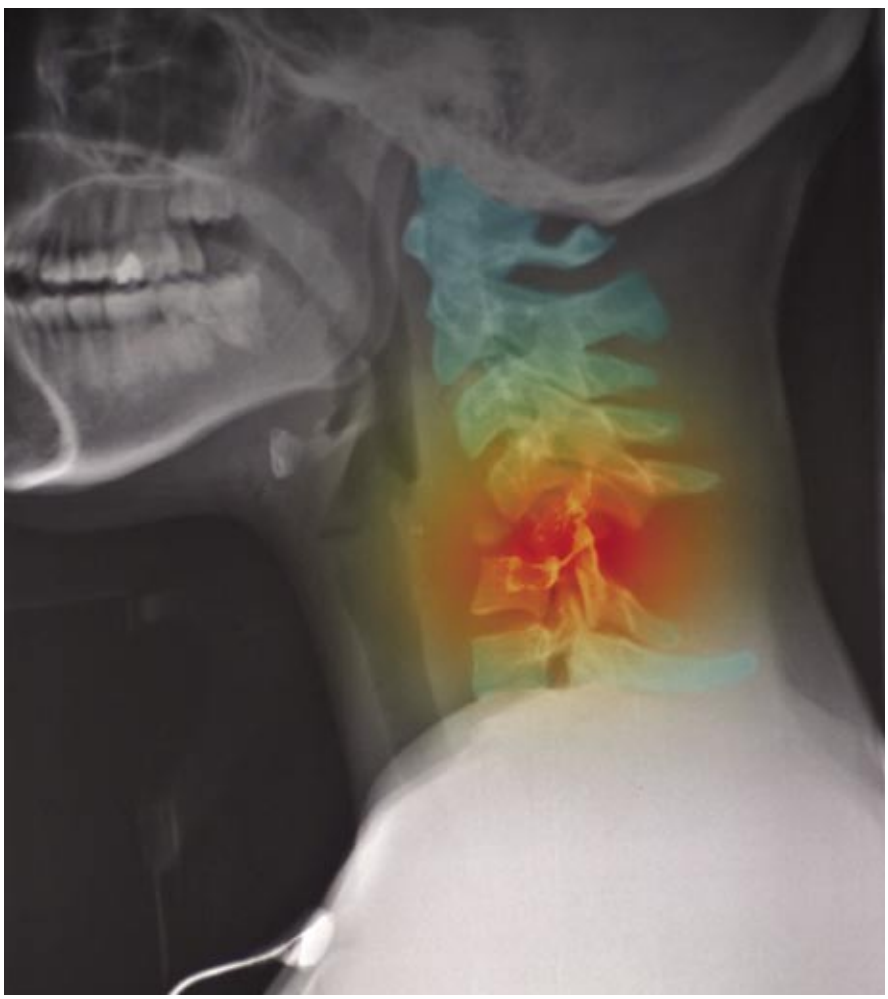
Combination therapy as the best approach for damaged spinal cords BY ANNA GRIFFITH

Ever since the 1940s, when researchers discovered that nerves of the spinal column can grow, scientists have tried to devise ways to coax the cells to overcome damaged areas and thereby defeat paralysis, organ degeneration and other problems associated with injury to the central nervous system. Removing scar tissue with drugs, laying down scaffolds and inserting cells have all been tried with varying degrees of success. Recent achievements, such as the restoration of some ability to walk in rodents, and other findings indicate that rather than a single approach, all may be the key. "A combination of drugs and cells gives better results than just any one of the components on their own," says Naomi Kleitman, a program director at the National Institutes of Health's National Institute of Neurological Disorders and Stroke.

Injury to nerves produces inflammation, ion imbalance, scar tissue and cysts filled with cerebrospinal fluid, which damage additional neurons and create a barrier against neuron growth. A lesion just one millimeter wide can increase to five to 10 millimeters, too large a gap for neurons to bridge. Surviving neurons often lose myelin, the insulation needed for reliable and quick signal transmission. About 200,000 people in the U.S. live with spinal cord injury.

Several compounds now in phase 1 clinical testing may counteract growth-blocking elements. BioAxone Therapeutic in Quebec found that 30 percent of patients improved after receiving Cethrin, a drug thought to counteract inhibition. Novartis has ATI-355, an antibody against the inhibitory protein NOGO. Researchers have shown in preclinical tests that an enzyme isolated from bacteria, chondroitinase, dissolves scar tissue.

Besides removing inhibition, scientists are promoting the growth of new neurons. Until five years ago, they could not control



SCOTT CAMAZINE *Photolake*

LOOKING TO RECONNECT: A combination of approaches seems essential to repair damaged tissue of the central nervous system. This x-ray of a neck fracture shows a complete spinal cord tear between cervical vertebrae five and six.