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## **IMPROVISED EXPLOSIVE DEVICES: BOOKLET OF RELATED READINGS 2**

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Joint Improvised Explosive Device Defeat Organizations*

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## PREFACE

This booklet represents the second in a series of compilations of print and electronic articles that are relevant to the defeat of improvised explosive devices (IEDs) that insurgent and terrorist operatives use to kill and injure U.S. military forces and civilian populations. The readings are related to IED technology, social networks that may provide insight into how insurgent groups communicate and relate to their members, and other technical and cultural phenomena that will help the Joint Improvised Explosive Defeat Organization (JIEDDO) meet its mission.

The first section of the booklet contains abstracts of the articles included in the booklet in alphabetical order by author and title. The abstracts are hyperlinked to the article itself located later in the booklet. At the end of each article is a hot link to the original article on the Internet. Information of particular relevance is highlighted in yellow.

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## ARTICLE ABSTRACTS

Bourzac, Katherine. “[Tiny, Sensitive Magnetic-Field Detectors](#),” *Technology Review*, November 16, 2007, <http://www.technologyreview.com/Biotech/19724/>.

This article presents similar information to one from *NewScientistTech* last week, but more directly addresses potential for use in detecting explosives. Researchers at the National Institute of Standards and Technology (NIST) have developed a new type of magnetic-field detector that rivals the sensitivity of its predecessors but is small and cheap, and uses very little power. Their size lends possibilities of using them in arrays to give more information about potential IEDs says the president of Geometrics, a company that makes magnetic sensors.

Bruno, Anthony. “[Who is Baitullah Mehsud?](#) (Part 1), *Court TV Crime Library*, November 19, 2007, [http://www.crimelibrary.com/news/original/1107/1901\\_war\\_room\\_baitullah\\_mehsud\\_1.html](http://www.crimelibrary.com/news/original/1107/1901_war_room_baitullah_mehsud_1.html).

The name of Baitullah Mehsud is emerging in Pakistani news as a potentially pivotal figure who could tip the increasingly precarious balance in Pakistan toward militant Islam.

Bruno, Anthony. “[Who is Baitullah Mehsud?](#) (Part 2), *Court TV Crime Library*, November 20, 2007, [http://www.crimelibrary.com/news/original/1107/2001\\_war\\_room\\_baitullah\\_mehsud\\_1.html](http://www.crimelibrary.com/news/original/1107/2001_war_room_baitullah_mehsud_1.html).

In this concluding part of the series, the author describes that Baitullah Mehsud has shown a disturbing interest in Dr. Abdul Qadeer Khan, the “father” of Pakistan's nuclear arms program, who in 2004 admitted to secretly selling nuclear technology to Iran, Libya and North Korea.

Burke, Jason. “[What role did al-Qaida play?](#)” *The Guardian* (UK), October 31, 2007, [http://commentisfree.guardian.co.uk/jason\\_burke/2007/10/what\\_role\\_did\\_al-qaida\\_play.html](http://commentisfree.guardian.co.uk/jason_burke/2007/10/what_role_did_al-qaida_play.html).

The author posits that the nature of modern Islamic militancy is associative and not hierarchical; moreover, it is based on who you know, who you come across and who influences you from your friends and associates. He adds that some thinkers in the British security services now feel that analysts skilled in “social movements” can be of great value in understanding these individuals.

Dumé, Belle. “[Laser fingerprint scanner does away with dusting](#),” *NewScientistTech*, November 16, 2007, <http://technology.newscientist.com/article/dn12931-laser-fingerprint-scanner-does-away-with-dusting.html>.

Scientists in India have developed a portable device that could scan fingerprints in microseconds. The system uses a technique called optical coherence tomography and promises to be better than existing fingerprint detection methods since it does not require any chemical processing.

Goetz, Thomas. “[23AndMe Will Decode Your DNA for \\$1,000](#); Welcome to the Age of Genomics,” *Wired*, November 17, 2007, [http://www.wired.com/print/medtech/genetics/magazine/15-12/ff\\_genomics](http://www.wired.com/print/medtech/genetics/magazine/15-12/ff_genomics).

New companies are offering to “read” your genomic profile — learning your predispositions for various diseases, odd traits, and a talent or two. Companies will take a sample of your DNA, scan it, and tell you about your genetic future, as well as your ancestral past and will also tell you which diseases and conditions are associated with your genes, calculating your genetic risk for a range of diseases. [Researcher Note: We already use DNA in identifying individuals; how else might we be able to use genomics in fighting terrorists?]

“[Google Meets Sherlock Holmes](#),” *ScienceDaily*, November 19, 2007, <http://www.sciencedaily.com/releases/2007/11/071114095244.htm>.

Researchers at the Department of Homeland Security Science and Technology Directorate are creating ways to see fuzzy (unstructured, such as information from photos, videos and voice) data as a 3-dimensional picture, where threat clues can jump out, working with the National Visualization and Analytics Center. [Researcher Note: Dr. Joseph Kielman is the DHS POC for this project; he is at (202) 254-5787]

“[How does the Brain Recognize a Face?](#)” *Physorg.com*, November 13, 2007, <http://www.physorg.com/news114192637.html>.

A team of eminent neuroscientists say they can predict with near-perfect accuracy whether two faces resemble each other enough to fool a human observer. [Researcher Note: To what degree could this research assist our on-going efforts at bio-metric identification and human observation in security situations?]

Kroeger, Alix. “[Survivors recall Baghlan bomb horror](#),” *BBC News*, November 14, 2007, [http://news.bbc.co.uk/2/hi/south\\_asia/7094434.stm](http://news.bbc.co.uk/2/hi/south_asia/7094434.stm).

Regional observers seem to believe that the recent suicide bombing in Baghlan, Afghanistan – that targeted a delegation of politicians – but killed 70 bystanders, was a milestone in the latest insurgency in that country. Article captures local feelings on the situation.

“[Researcher models effects of suicide bombing: results of crowd configurations](#),” *EurekAlert!* November 13, 2007, [http://www.eurekalert.org/pub\\_releases/2007-11/fiot-rme111307.php](http://www.eurekalert.org/pub_releases/2007-11/fiot-rme111307.php).

Modeling project indicates that various crowd formations exacerbate or minimize injuries and fatalities in the event of a pedestrian suicide bomb attack. Project leader plans to continue the research, integrating several physical and social variables into the simulation. These include modeling physical objects such as landscape and furniture, and such social variables as crowd behaviors. [Researcher Note: To what extent could this project assist in counter-IED activities modeling?]

Sauser, Brittany. “[Stopping Cars with Radiation](#),” *Technology Review*, November 13, 2007, <http://www.technologyreview.com/Infotech/19699/?a=f>.

The concept of disabling vehicles' electronic system with microwaves was first tested in 1997 by the U.S. Army using bulky and heavy military equipment. This system is much smaller and has been tested on a variety of stationary vehicles and could be ready for deployment in automobiles within 18 months. Initial funding for the project came from the U.S. Marine Corp, but now Eureka Aerospace is looking to other governmental agencies for financial support as the company continues to work to make the device smaller, lighter, and more efficient. [Researcher Note: This is obviously a classified program; have we already examined its potential to assist our own efforts?]

Shahzad, Syed Saleem. “[Pain has become the remedy](#),” *Asia Times Online*, November 14, 2007, [http://www.atimes.com/atimes/South\\_Asia/IK14Df04.html](http://www.atimes.com/atimes/South_Asia/IK14Df04.html).

This is Part 2 (and final) of a series on the rise of the Taliban. The author has visited with Taliban leaders twice in the last year and describes the new leadership and operations to fight Coalition forces in Afghanistan and the Pakistani Army. This part discusses Punjabi participation with the guerillas and the link with the Lashkar-e-Taiba (LeT), a Pakistani jihadi group focused on the struggle to regain Indian-administered Kashmir.

Simonite, Tom. “‘[Poor man’s broadband](#)’ has a turn of speed,” *NewScientistTech*, November 18, 2007, <http://technology.newscientist.com/article/mg19626305.900-poor-mans-broadband-has-a-turn-of-speed.html>.

New development allows downloading of large files by avoiding the internet. System is based on P2p software called BigTorrent.

Spengler, “[Israel, the hope of the Muslim world](#),” *Asia Times Online*, November 20, 2007, [http://www.atimes.com/atimes/Middle\\_East/IK20Ak01.html](http://www.atimes.com/atimes/Middle_East/IK20Ak01.html).

This is an out-of-the-mainstream think piece on democracy in the Muslim world. The author states that conventional wisdom in the foreign ministries of the West is that relations with Muslims would be much easier without the annoying presence of the Jewish state, which humiliates the Muslim world. He then posits that Israel embodies the

last, best chance for the Islamic world to come to terms with the modern world, because humility is a central premise of democracy.

Taheri, Amir. “[Afghanistan: What is Required?](#)” *Asharq Al-Awsat*, November 16, 2007, <http://www.asharqalawsat.com/english/news.asp?section=2&id=10885>.

Respected columnist with *Asharq Al-Awsat*, the leading Arabic international daily, weighs in with an assessment on Afghanistan. He presents six indicators that suggest that the Afghan government is gaining the upper hand. However, he notes that a key condition for winning a war against insurgents is to have a unified command and control system capable of deploying resources to maximum effect where needed in an expeditious manner and that in Afghanistan there are four separate command structures.

## ARTICLES



## Who is Baitullah Mehsud? (Part 1)

Anthony Bruno, November 19, 2007



### Baitullah Mehsud

"Allah on 480 occasions in the Holy Koran extols Muslims to wage jihad. We only fulfill God's orders. Only jihad can bring peace to the world...We will continue our struggle until foreign troops are thrown out. Then we will attack them in the US and Britain until they either accept Islam or agree to pay jizya (a tax in Islam for non-Muslims living in an Islamic state)." These are

the words of Baitullah Mehsud, militant leader of the Mehsud tribe of the Pashtun ethnic group, from a *BBC* interview in January 2007.

Baitullah Mehsud is not a household name—yet. Terrorist leaders tend to be nameless and faceless until their deeds earn them infamy. Osama bin Laden's name was largely unknown to the public until Sept. 11, 2001. But with General Pervez Musharraf's recent imposition of emergency rule in Pakistan and his desperate struggle to hang onto power, Baitullah's name has begun to emerge in daily news reports coming out of Pakistan. Some portray him as an annoying stone in Musharraf's shoe, just one of several problems confronting the general. **But others see Baitullah as a pivotal figure, who could tip the political balance in Pakistan toward militant Islam and spark terror attacks throughout the world.**



### General Pervez Musharraf

Baitullah commands a force of 20,000 to 30,000 fighters in the tribal areas of northwest Pakistan. He has dispatched suicide-bombers to kill Pakistani police and soldiers in Swat, Kohat, Bannu, Dera Ismail Khan, and Peshawar. On August 30, his forces brazenly captured 213 Pakistani soldiers and held them hostage for two months until his demands were met. One day after declaring the current state of emergency, General Musharraf reached a settlement with Baitullah, exchanging 25 militants in government custody for the captured troops. Musharraf later admitted that these men were trained suicide bombers, and one of them was under indictment for participating in a suicide bombing. As part of the deal, Baitullah agreed to expel foreign militants from his territories and stop

attacking the army. But Baitullah has signed peace accords with the Pakistani government before

and reneged on his word. Baitullah has no formal education or religious schooling but is a natural leader with keen political instincts. He controls a critical battleground in the war on terror, South Waziristan, a tribal territory in Pakistan on the Afghanistan border about the size of New Jersey. The Taliban currently thrive in this region and Al Qaeda is welcome there. There's a better than even chance that Osama bin Laden is living somewhere in Waziristan under Baitullah's protection.



Baitullah's advocates say he has brought peace to the region, but detractors note that the peace came at a price—literally. Like a Mafia boss, he and his lieutenants shake down the populace for protection money. He's closely allied to Taliban leader Mullah Omar, and, like the Taliban, he enforces an extreme form of Shariah in his territory. Women must observe a strict form of purdah, and men are forbidden to shave their beards. Playing music and watching videos are against the law. He has ordered the murder of adulterers by stoning. There are few Pakistani government courts in the region,

and the Waziristanis seldom use them. Instead they go to Baitullah to settle their differences. In South Waziristan and parts of North Waziristan, he is the law.



### Benazir Bhutto

Baitullah is said to have a signature method of dealing with people he deems disloyal. He first sends the offender 1,000 rupees, a spool of thread, a needle, and a note instructing the person to have a kafan (burial shroud) made within 24 hours. When the time is up, the person is murdered.

Baitullah is also said to have ordered the suicide-bomber attack on Benazir Bhutto the day after she returned to the country on October 18, 2007. The explosions were close enough to Bhutto's car to shatter the windshield. Baitullah denies that he was behind the attack, though it's no secret that he despises her for her pro-American stance. He also opposes Musharraf for the same reason.

Both the Taliban and Al Qaeda have sought his support to accomplish their particular goals. The Taliban want to concentrate their efforts on waging war in Afghanistan and regaining control there. Al Qaeda militants want a worldwide jihad against all governments aligned with the United States, starting with Pakistan. Baitullah can send forces east into Afghanistan to help Taliban fighters or keep them in Pakistan to undermine the government. So far he has done both.

Since Sept. 11, 2001, the United States has given Pakistan \$10 billion to help fight terrorism. But some believe that some of that money found its way into Baitullah Mehsud's accounts. If so,

what has he done with it? Is he content to serve the interests of the Taliban and Al Qaeda, or does he have ambitions of his own—even nuclear ambitions?

[http://www.crimelibrary.com/news/original/1107/1901\\_war\\_room\\_baitullah\\_mehsud\\_1.html](http://www.crimelibrary.com/news/original/1107/1901_war_room_baitullah_mehsud_1.html)

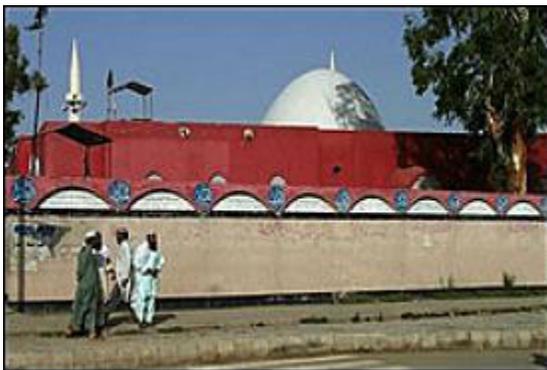


## Who is Baitullah Mehsud? (Part 2)

Anthony Bruno, November 20, 2007

Tribal militant leader Baitullah Mehsud has shown a disturbing interest in Dr. Abdul Qadeer Khan, the controversial father of Pakistan's nuclear arms program.

Tribal militant leader Baitullah Mehsud has shown a disturbing interest in Dr. Abdul Qadeer Khan, the controversial father of Pakistan's nuclear arms program, who in 2004 admitted to selling nuclear technology to Iran, Libya, and North Korea on the black market. Dr. Abdul Qadeer Khan reported that when Benazir Bhutto returned to Pakistan in October of this year, Baitullah instructed Al Qaeda militants in Karachi to kill her for "three major offenses against Islamists." First, she supported the Pakistani military attack on Lal Masjid (the Red Mosque) in Islamabad on July 10, 2007



### Lal Masjid, the Red Mosque

Lal Masjid was considered a hotbed of Islamist radicalism; one hundred and sixty-four Pakistani special-forces commandos stormed the mosque and madrassah, killing at least 20 and injuring over 100. Second, Bhutto has made it clear that if she takes power in Pakistan, she will allow American forces to search for Osama bin Laden inside Pakistan's borders. Third, she has said that if

elected, she would allow the International Atomic Energy Agency to question A. Q. Khan.

Why does Baitullah care about Khan? Is he trying to protect a valuable asset in the international terrorist community? Or does he fear that Khan will implicate others in his nuclear dealings, possibly including warlords like Baitullah or their Islamist allies within the Pakistani security and intelligence services?

Though he claims to be motivated by his deep devotion to Islam, Baitullah doesn't shun a profit when there's one to be made. The Taliban paid him \$70,000 to hunt down diplomats from

countries that published cartoons depicting Allah. On February 8, 2005, Baitullah and four other militant tribal leaders signed a peace agreement with the Pakistani government. They drove a hard bargain, agreeing to sign only after being paid \$540,000. As part of the agreement, Baitullah promised not to support the Taliban or Al Qaeda, but at the peace negotiations he openly swore his allegiance to the Taliban's Mullah Omar. In demanding higher payments, the other leaders said that they needed more money because they were in debt to Al Qaeda and felt it was a matter of honor to pay off that debt. The United States has given Pakistan over \$10 billion in aid since Sept. 11, 2001. Did the money that was paid to these militant leaders come from the American purse, and did it ultimately thereby find its way to America's sworn enemies?



### Taliban's Mullah Omar

With Pakistan still in the tight grip of emergency rule, American officials worry that General Musharraf will pull troops out of the tribal regions to maintain law and order in Pakistan's cities. Baitullah has been a major problem for the military in his territories. There's no telling what he might do if the military presence in North and South Waziristan is reduced or eliminated.

Until 2005, Baitullah lived in the shadow of his daring and charismatic brother, Abdullah Mehsud, who, with his long black hair, was considered a terrorist rock star. Abdullah fought with the Taliban in Afghanistan against the Northern Alliance and in 1996 lost a leg when he stepped on a land mine.



### Abdullah Mehsud

He was taken captive by warlord Abdul Rashid Dostum [see below] who turned him over to American forces. Abdullah Mehsud was sent to Camp Delta at Guantanamo Bay Naval Base in Cuba and held for two years, insisting the whole time that he was just an innocent tribesman. He was released in 2004 for reasons which remain unclear and returned to Waziristan.



### Abdul Rashid Dostum

Soon after his return, he orchestrated the kidnapping of two Chinese engineers working on a dam in his region, proclaiming that Beijing was guilty of killing Muslims. He also ordered an attack on Pakistan's Interior Minister in which 31 people perished. In July 2007 he died in a clash with Pakistani military forces as they raided his residence.

By contrast, Baitullah keeps a much lower profile. He refuses to be photographed and keeps his face covered in public. He reaches out to his people through FM radio broadcasts. He crosses the border into Afghanistan at

will to fight against the "crusaders." Left unchecked, it's uncertain where and with whom he will strike next.

Baitullah made his intentions clear this past January when he said, "As far as jihad is concerned, we will continue to wage it. We will do what is in the interest of Islam." Speaking of the growing threat of Baitullah's militia, Pakistani military analyst, Hasan-Askari Rizvi, told *The New York Times*, "The army has never faced such a serious challenge in the tribal areas."

[http://www.crimelibrary.com/news/original/1107/2001\\_war\\_room\\_baitullah\\_mehsud\\_1.html](http://www.crimelibrary.com/news/original/1107/2001_war_room_baitullah_mehsud_1.html)



## What role did al-Qaida play?

Jason Burke, October 31, 2007

A walk through the run-down Lavapiès quarter of Madrid and through the crowded Mazouk area of Tetouan, the northern Moroccan city, will tell you more about modern Islamic militancy than any number of studies of al-Qaida. In both you will see large numbers of young men, sitting, standing, talking, smoking, in internet cafes, on street corners, in coffee shops. People come and go. Friends arrive, greet each other and leave. Small groups form and then split up, only to reform elsewhere. Over a number of days spent in both locations in the last year, one element struck me: none of the groups, excepting those on their way to football matches as spectators or players, or, on Fridays in particular, on their way to or from prayers, ever numbered more than half a dozen. There was usually a couple of individuals who were more confident, more assured, louder, two or three who are clearly hangers-on and then some in the middle. Around them all circulated a larger number of acquaintances and contacts: some there for the ride, others with specific attributes such as a car, a cafe, a shop, hashish. The groups' composition was that of most terrorist groups.

Of course, not every bunch of young men hanging around street corners in rough areas of Mediterranean towns are potential terrorists - though many rightwing commentators seem to think so - but the scene in Mezouak and Lavapiès highlights the nature of modern Islamic militancy. It is associative, not hierarchical; based on who you know, who you come across, who influences you amid your friends and associates, in exposure to a new version of a virulent Muslim revivalist ideology with a strong political flavour. It is not for nothing that the thinkers British security services now feel bring the best analysis to terrorism are those working in "social movements". Mezouak and Lavapiès are the two central locations in the bombing of Madrid in March 2004.

Not only has the trial that finished today of those responsible for the attack unpicked one of the most cynical attempts by any government of recent times to distort public understanding of such an event - the bid by Spain's conservative government to label the attacks as the work of Basque separatists - but they have also helped undermine the idea, still surprisingly widespread, that the global wave of violence associated with modern extremist Islamic militancy that we have seen in the past 10 years is all orchestrated by some kind of giant, sprawling terrorist organisation called al-Qaida.

Nothing in the four-month trial indicated that this might be the case. And though "al-Qaida", understood as Osama bin Laden and his close associates, did indeed play a role, it was far from that usually ascribed to them.

The first elements of the plot came together in late 2002 with a rough group of like-minded immigrants from the Maghreb who met in a flat to watch videos of "atrocities committed against Muslims", in the words of a police informer, and sing Jihadi songs. Some were childhood friends, others merely thrown together by chance. The strongest personality among them was Serhane Abdelmajid Fakhed, an economics student who had come to Spain on a scholarship.

Though there was much discussion of jihad, no practical plans were formed until, hanging around on Tribulete Street in Lavapiès, Serhane met an active, violent and profoundly anti-Semitic Moroccan drug trafficker, Jamal Ahmidan, who had become radicalised when serving 18 months in prison in Morocco for narcotics offences. According to the fine, and currently unpublished work, by two of the best analysts working on radical Islam, Scott Atran and Marc Sageman, the two men washed with holy water from Mecca at the Tangiers Barber Shop, shopped at the al-Manara halal butcher shop, eat at the Alhambra Restaurant, and spent hours at a mobile phone and internet store run by another member of Serhane's circle who would ultimately provide detonators and place some of the bombs on the trains.

And so it continues. To the religious group around Serhane, was added the various petty criminal contacts of the frightening, strong-minded Ahmidane. Over the next months, a series of largely fortuitous contacts, all through mutual friends, relatives, associates, would lead to further advances in the plot, bringing in explosives, runners, further recruits. The final element came in the form of a group of young school friends from Tetouan. As Atran and Sageman, a former CIA officer and a trained clinical psychologist, these last contacts were made in prison, through playing amateur soccer and at a mosque. This group was once identical to those I saw on the streets of Jamaal Mezouak except they ended up blowing themselves up in the bombers' last stand when cornered by the Spanish police after the attacks. In all 40 people are believed to be linked to the plot. Nearly 200 died.

So where is al-Qaida in all this? Certainly not in the funding. The attacks cost an estimated £30,000. Ahmidan the drug dealer drove a 5-series BMW and police found stocks of cannabis and ecstasy worth £1m after the attack. Nor in the training. There is no evidence that any of the bombers travelled to Pakistan as British militants have done for instruction in bomb-making techniques.

Yet al-Qaida did play a role. As late as November 2003, the two prime movers of the plot, Ahmidan and Serhane, were unsure of where and what to strike. Yet a detailed attack plan came in late December, shortly after the internet tract "Iraqi Jihad, Hopes and Risks" began to circulate a call for "two or three attacks ... to exploit the coming general elections in Spain in March 2004". The tract had appeared on a radical Islamic website which Serhane's circle had been systematically using for months. The exact provenance of the document is unclear - Atran and Sageman attribute it to Abu Musab al-Zarqawi, the Jordanian militant leader active in Iraq at the time, rather than al-Qaida itself - but it does appear to have influenced the plotters in giving their plans, in the way that senior militant leaders like Bin Laden have done for decades, a legitimacy and a direction that they had previously lacked.

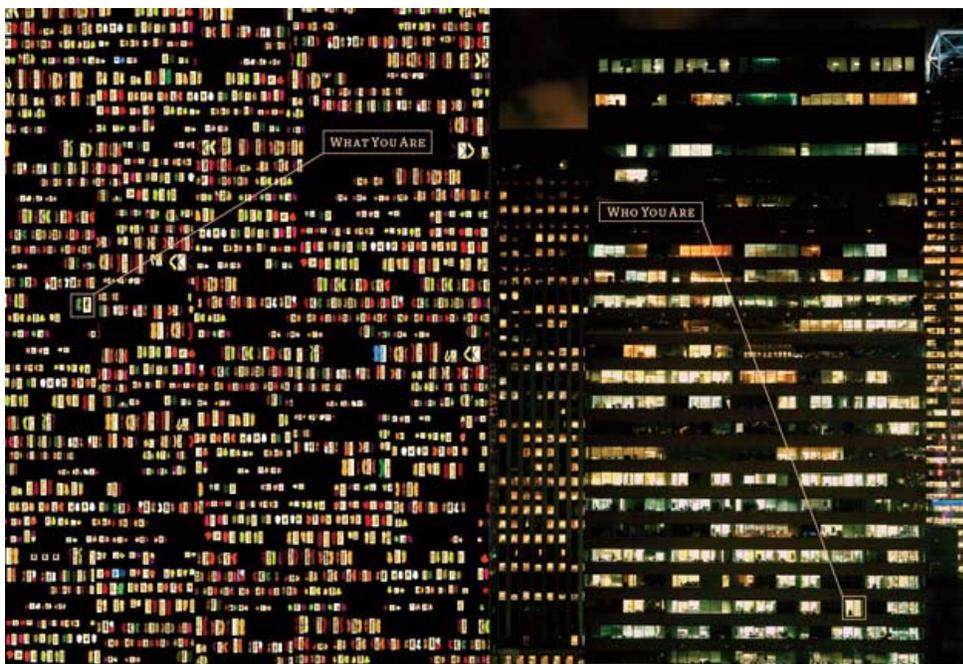
Is this al-Qaida the global network capable of striking all over the world, triggering carefully hidden sleeper cells at will? Not really. The Madrid bombings were the work of a disparate group of individuals drawn together by two motivated, angry, twisted individuals who were heavily influenced by something that might be called "al-Qaida-ism" but whose links to any global terrorist group were very scant indeed. And that is the nature of modern Islamist militancy. And that is not good news.

[http://commentisfree.guardian.co.uk/jason\\_burke/2007/10/what\\_role\\_did\\_al-qaida\\_play.html](http://commentisfree.guardian.co.uk/jason_burke/2007/10/what_role_did_al-qaida_play.html)

# WIRED

## 23AndMe Will Decode Your DNA for \$1,000. Welcome to the Age of Genomics

By Thomas Goetz, November 17, 2007



*Left: Courtesy Sandra Burkett, National Cancer Institute, CCR; Right: Frank Schwere*

At the age of 65, my grandfather the manager of a leather tannery in Fond Du Lac, Wisconsin, suffered a severe heart attack. He had chest pains and was rushed to the hospital. But that was in 1945, before open heart surgery, and he died a few hours later. By the time my father reached 65, he was watching his diet and exercising regularly. That regimen seemed fine until a couple of years later, when he developed chest pains during exercise, a symptom of severe arteriosclerosis. A checkup revealed that his blood vessels were clogged with arterial plaque. Within two days he had a triple bypass. Fifteen years later (15 years that he considers a gift), he's had no heart trouble to speak of.

I won't reach 65 till 2033, but I have long assumed that, as regards heart disease, my time will come. My genes have predetermined it. To avoid my father's surgery, or my grandfather's fate, I try to eat healthier than most, exercise more than most, and never even consider smoking. This, I figure, is what it will take for me to live past 65.

Turns out that my odds are better than I thought. My DNA isn't pushing me toward heart disease — it's pulling me away. There are established genetic variations that researchers associate with a higher risk for a heart attack, and my genome doesn't have any of those negative mutations; it

has positive mutations that actually reduce my risk. Like any American, I still have a good chance of eventually developing heart disease. But when it comes to an inherited risk, I take after my mother, not my father.

Reading your genomic profile — learning your predispositions for various diseases, odd traits, and a talent or two — is something like going to a phantasmagorical family reunion. First you're introduced to the grandfather who died 23 years before you were born, then you move along for a chat with your parents, who are uncharacteristically willing to talk about their health — Dad's prostate, Mom's digestive tract. Next, you have the odd experience of getting acquainted with future versions of yourself, 10, 20, and 30 years down the road. Finally, you face the prospect of telling your children — in my case, my 8-month-old son — that he, like me, may face an increased genetic risk for glaucoma.

The experience is simultaneously unsettling, illuminating, and empowering. And now it's something anyone can have for about \$1,000. This winter marks the birth of a new industry: Companies will take a sample of your DNA, scan it, and tell you about your genetic future, as well as your ancestral past. A much-anticipated Silicon Valley startup called *23andMe* offers a thorough tour of your genealogy, tracing your DNA back through the eons. Sign up members of your family and you can track generations of inheritance for traits like athletic endurance or bitter-taste blindness. The company will also tell you which diseases and conditions are associated with your genes — from colorectal cancer to lactose intolerance — giving you the ability to take preventive action. A second company, called *Navigenics*, focuses on matching your genes to current medical research, calculating your genetic risk for a range of diseases.

The advent of retail genomics will make a once-rare experience commonplace. Simply by spitting into a vial, customers of these companies will become early adopters of personalized medicine. We will not live according to what has happened to us (that knee injury from high school or that 20 pounds we've gained since college) nor according to what happens to most Americans (the one-in-three chance men have of getting cancer, or women have of dying from heart disease, or anyone has for obesity). We will live according to what our own specific genetic risks predispose us toward.



**At Illumina, a San Diego biotech firm, customer DNA is analyzed in the "decoding bay." Photo: Brent Humphreys**

This new industry draws on science that is just beginning to emerge. Genomics is in its earliest days: The Human Genome Project, the landmark effort to sequence the DNA of our species, was completed in 2003, and the research built on that milestone is only now being published. The fact that any consumer with

\$1,000 can now capitalize on this project is a rare case of groundbreaking science overlapping with an eager marketplace. For the moment, *23andMe* and *Navigenics* offer genotyping: the strategic scanning of your DNA for several hundred thousand of the telltale variations that make

one human different from the next. But in a few years, as the price of sequencing the entire genome drops below \$1,000, all 6 billion points of your genetic code will be opened to scrutiny.

To act on this data, we first need to understand it. That means the companies must translate the demanding argot of genetics — alleles and phenotypes and centromeres — into something approachable, even simple, for physicians and laypersons alike. It's one thing for a doctor to tell patients that smoking is bad for them, or that their cholesterol count is high. But how are you supposed to react when you're told you have a genetic variation at rs6983267 that's been associated with a 20 percent higher risk of colorectal cancer? And what are physicians, most likely untrained in and unprepared for genomic medicine, to do when a patient comes in wielding a printout that indicates a particular variation of a particular gene?

This new age of genomics comes with great opportunity — but also great quandaries. In the genomic age, we will no longer have the problem of not knowing, but we will face the burden of whether we want to know in the first place. We'll learn what might be best for us in life and then have to reckon with the risk and perhaps the guilt of not acting on that knowledge. We will, counter-intuitively, face even more pressure to conduct our lives carefully, strictly, and cautiously; we'll practice the art of predictive diagnosis and receive a demanding roster of things to avoid, things to do, and treatments to receive — long before there's any physical evidence of disease. And, yes, we will know whether our children are predisposed to certain traits or talents — athletics or music or languages — and encourage them to pursue certain paths. In short, life will become a little more like a game of strategy, where we're always playing the percentages, trying to optimize our outcomes. "These are enormously large calculations," says Leroy Hood, a pioneer of genomic sequencing and cofounder of the Institute for Systems Biology in Seattle, who suggests that if we pay attention and get the math right, "it's not a stretch to say that we could increase our productive lifespans by at least a decade."

**The question was surely strange.** In February 2005, Anne Wojcicki sat down at the so-called Billionaires' Dinner, an annual event held in Monterey, California, and asked her tablemates about their urine. She was curious whether, after eating asparagus, they could smell it when they urinated. Among those at her table were geneticist Craig Venter; Ryan Phelan, the CEO of DNA Direct, a San Francisco genetic-testing company; and Wojcicki's then-boyfriend (and now husband), Sergey Brin, cofounder of Google. Most could pick up the smell of methyl mercaptan, a sulfur compound released as our guts digest the vegetable. But some had no idea what Wojcicki was talking about. They had, it seems, a genetic variation that made the particular smell imperceptible to them.

Soon, the conversation turned to a growing problem: While researchers are amassing great knowledge about certain genes and genetic variations, there is no way for people to access that data for insights about themselves and their families — to Google their genome, as it were. As a biotech and health care analyst at Passport Capital, a San Francisco hedge fund firm, Wojcicki knew that the pharmaceutical industry was already at work on tailoring drugs to specific genetic profiles. But she was intrigued by the prospect of a database that would compile the available research into a single resource.

Linda Avey wasn't at the dinner, but she wished she had been when she read about it later that year in David Vise and Mark Malseed's book, *The Google Story*. At the time, Avey was an executive at Affymetrix, the company that had pioneered some of the tools for modern genetic research. For nearly a year, she had been mulling the idea of a genotyping tool for consumers, one that would let them plumb their own genome as well as create a novel data pool for researchers. She even had a placeholder name for it: Newco. "All the pieces were there," Avey says. "All we needed was the money, as usual, and computational power." Two things that Google has plenty of. Around the time she read Vise and Malseed's book, Avey had a dinner scheduled with a Google executive. She asked Wojcicki to join them, and the two quickly hit it off. Within a few months, they had settled on the idea behind 23andMe: Give people a look at their genome and help them make sense of it. (The company's name is a reference to the 23 pairs of chromosomes that contain our DNA.)

Brin offered to be an angel investor. "Sergey was like, Come up with something in three months and launch it," Wojcicki says. "We thought it would be so fast." In fact, the project took more than 18 months from conception to launch. Last spring, Google invested \$3.9 million in 23andMe (part of the proceeds repaid Brin, who has since recused himself from the investment). The company, which now has more than 30 employees in a building down the road from Google, feels very much like the quintessential startup. In the entry hall, alongside two Segways (a gift from inventor Dean Kamen), stands a herd of pedal-pusher bicycles. On a whiteboard in the hall, someone has scrawled an anxiety meter. *Current threat level: slight deformation* (engineering-speak for moderate stress). But that level had been crossed out and the alert upped to *bananas*.

Still, 23andMe is hardly a typical Valley outfit. Instead of widgets and Ajax apps, the cubicle chatter more likely concerns Klinefelter's syndrome and hermaphrodites. Such banter underscores a major challenge for the company: making customers comfortable with the strange vocabulary and discomfiting implications of genetics. As Avey notes, when you're asking your customers for their spit, best to have an especially strong relationship.

A lot of spit, as it turns out. It takes about 10 minutes of slaving to fill the 2.5-milliliter vial that comes in the fancy lime box provided by 23andMe. Wrap it up, call FedEx, and two to four weeks later you get an email inviting you to log in and review your results. There are three main sections to the Web site: Genome Labs, where users can navigate through the raw catalog of their 23 pairs of chromosomes; Gene Journals, where the company correlates your genome with current research on a dozen or so diseases and conditions, from type 2 diabetes to Crohn's disease; and Ancestry, where customers can reach back through their DNA and discover their lineage, as well as explore their relationships with ethnic groups around the world. Family members can share profiles, trace the origin of particular traits, and compare one cousin's genome to another in a fascinating display of DNA networking. Avey herself has had roughly 30 members of her extended family genotyped, spanning four generations. The effort has turned her clan into what is likely the most thoroughly documented gene pool in the world.

It's the Gene Journals, though, that could really change people's lives. Here customers learn their personalized risk for a particular condition, calculated according to whether their genotype contains markers that research has associated with specific risks. Wojcicki stresses, though, that 23andMe's results are not a diagnosis. "It's simply your information," she insists. In part, this

distinction is to make sure the company doesn't run afoul of the Food and Drug Administration, which strictly regulates diagnostic testing for disease but has been slow to respond to the more transformational aspects of genomics. But the caveat also matters because the influence of genetics varies from disease to disease; some conditions have a strong heritable component, while others are determined more by environmental factors.

With its emphasis on disease risks, Navigenics is more comfortable offering something closer to a diagnosis. "If I tell you you've got a genetic likelihood of getting colon cancer, you're going to get a colonoscopy early," says Navigenics' cofounder David Agus, a prominent oncologist and director of the Spielberg Family Center for Applied Proteomics at Cedars-Sinai Medical Center in Los Angeles. "And that's going to save lives."

Both companies draw a good lesson from the bad example of the body scan industry. When storefront CT scanning machines popped up in the late 1990s, the idea seemed golden to many radiologists and entrepreneurs: Customers could go directly to an imaging center and get an early look at possible tumors or polyps for about \$1,000. But the market cratered by 2005, when it became evident that insurers wouldn't pay for the scan without a prior diagnosis and customers wouldn't pay out of pocket for frequent scans. What's more, the false-positive rate was jarringly high, and anxious customers often raced back to their doctor with an image showing, for instance, benign kidney or liver cysts, only to be told that they were harmless incidental lumps.

In other words, there was too much noise and not enough signal. So both 23andMe and Navigenics are determined not to simply shovel along raw research, with scary one-off results indistinguishable from well-established correlations. In-house experts at both companies have filtered and vetted hundreds of studies; only a handful are deemed strong enough to incorporate into their library of conditions, which is used for personalized risk calculations. The hope is that this will reduce or eliminate false alarms and let customers trust the experience — maybe even enjoy it.

One afternoon I was working up my own 2.5 milliliters of spit at the company's office when Jimmy Buffett dropped by to get an early peek at his results. A few months earlier, the singer had let 23andMe peruse his genotype and compare his genealogy to Warren Buffett's. The two men had long wondered if they were somehow related (they aren't, it turns out). Now Jimmy wanted to check out the whole experience. He sat down in front of a laptop in Wojcicki's office, and she looked over his shoulder, guiding him through the site. First he clicked through his ancestral genome, noting that his maternal lineage showed a strong connection to the British Isles. "So the women came over with the Saxon invasion; pretty cool," he said. Another click and he perused his similarity to other ethnic groups, spotting a strong link to the Basque region of Spain. "No wonder I like Basque food so much," he noted.

Then he clicked over to see his disease risks — and was transfixed. "Wow. Right, that's about right for my family," he said as he ran through various conditions. After about 45 minutes of self-discovery, he leaned back in his chair to put it all together. "Boy, this can get pretty fascinating. And every time some research comes out, I can log on and see how it works for me. I get it," Buffett said with a laugh. "You guys are mad scientists."

**Gregor Mendel began growing** peas in his abbey garden in the 1850s, just a simple monk curious about the differences among the plants. A member of the Augustinian order, Mendel took to his garden experiments with characteristic discipline and rigor. He grew some peas with green seeds and others with yellow ones, some with violet flowers and others with white, some with round seed pods and others with wrinkled pods, and so on — at least 10,000 plants in all. By the time he was done, he had established the principles of genetic inheritance, identifying some traits as dominant and others as recessive. (Less celebrated is his later work breeding honeybees; though his hybridized African and South American bees produced wonderful honey, they were exceptionally vicious, and he destroyed them.)

More than a century later, Mendel's basic concepts remain the cornerstone of genetics. We now understand his traits as genes, and genes as sections of DNA — a strand of 3 billion pairs of ATGC (adenine and thymine, and guanine and cytosine), the nucleotides that compose our genome.

Since 1983, when the gene associated with Huntington's disease was first linked to a particular chromosome, most genetic discoveries have worked like Mendel's peas: They have focused on traits associated with single genes. These so-called monogenic conditions — diseases like hemochromatosis (where the body absorbs too much iron) or Huntington's disease — are easy to research, because the associations are pretty much binary. If you have the genetic mutation, you're almost certain to develop the disease. That makes them easy to screen for, too. There are now tests for more than 1,400 of these diseases: prenatal screening for cystic fibrosis, mutations in BRCA1 and BRCA2 genes that convey a strong risk for breast cancer, and so forth. This is the sort of genetic testing most of us are familiar with. And such screening can be extremely useful. Careful testing for Tay-Sachs disease among Ashkenazi Jews, for instance, has led to a 90 percent reduction in the disease in the US and Canada.

But as genetic research has progressed, the idea that most diseases will have a clearly defined, single genetic component — what's known as the "common disease, common gene" hypothesis — has turned out to be mostly wishful thinking. In fact, the 1,400 conditions that are currently tested for represent about 5 percent of diseases in developed countries, meaning that for 95 percent of diseases there's something more complicated going on.

Most conditions, it turns out, develop from a subtle interplay among several genes. They are said to be multigenic, not monogenic. And while scientists have made progress connecting the deterministic dots between rare genes and rare conditions, they face a far greater challenge understanding the subtler genetic factors for those more common conditions that have the major impact on society. "We're learning plenty about the molecular basis of disease — that's the revolution right now," says Eric Lander, founding director of the Broad Institute and one of the leaders of the Human Genome Project. "But whether that knowledge translates into personalized predictions and personalized therapeutics is unknown." In other words, not all genes are as simple to understand as Mendel's peas.

The source of this complexity lies in our SNPs, or single nucleotide polymorphisms, the single-letter mutations among the base pairs of DNA — swapping an A for a G, or a T for a C — that largely determine how one human is genetically different from another. Throughout our 6 billion

bits of genetic code, there are millions of SNPs (pronounced "snips"), and some untold number of those play a role in our predilection for disease. For researchers like Lander, the main challenge is establishing which SNPs — or which constellation of SNPs — affect which conditions.

Consider, for instance, the many ways that a human heart can go bad. The arteries supplying blood to the heart can be clogged with plaque, constricting blood flow until the organ goes into arrest. Or a valve in the heart can leak, spilling blood into the lungs and causing pulmonary edema. Or the tissues of the organ itself can be weakened, as in cardiomyopathy, so that the muscle fails to pump enough blood throughout the body. Each of these conditions has specific terminology, causes, and treatments, but they are all versions of heart disease, which is the leading killer in the US. And each condition may have its own genetic component, or be influenced by a range of genetic components, with each case of the illness a unique combination of genetic variables and environmental factors. So establishing the genetic component of heart disease means, in actuality, accounting for a daunting variety of conditions and tracking the influence of a broad number of genetic variations, as well as separating them from environmental components.

Now, thanks to a series of complementary innovations, geneticists have begun teasing apart the complexity. First, the Human Genome Project, completed in 2003, provided a map for our common genomic sequence. Next, 2005 saw the completion of the first phase of the International HapMap Project, a less-celebrated but equally ambitious effort that cataloged common patterns of genetic variations, or haplotypes, SNP by SNP. That helped researchers know where they should focus their attention. And finally, by mid-2006 the price of genotyping microarrays — the matchbox-sized chips that can detect SNP variations from genome to genome — had dropped to a level that let scientists greatly increase the pace and scope of their research.

As these three factors have converged, the pace of discovery has taken off, producing a startling number of new associations between SNPs and disease. Even the sober *New England Journal of Medicine* described trying to keep up with the research as "drinking from the fire hose." Lander calls it a 20-year dream coming to fruition. "2007 has been one of those magical years where the entire picture comes into focus. Suddenly we have the tools to apply to any problem: cancer, diabetes — a huge list of diseases. It's just a stunning explosion of data. Pick a metaphor: We've now landed on this new continent, and the people are out there exploring it, and we're finding mountains and waterfalls and rivers. We're turning on lights in dark rooms. We're finding pieces to the jigsaw puzzle."

Clearly, this is an exciting time to be a geneticist. And, it turns out, a consumer, too.

**Come late September**, Avey and Wojcicki invited their board of scientific advisers to Mountain View, California, for one last review of the site before launch. The meeting began around noon. Avey, as is her habit, had been going strong since 4o'clock that morning. Wojcicki was less sprightly, having just returned the previous night from her three-week honeymoon with Brin on safari in Africa and sailing around Greece and Turkey; she was also coming down with a nasty cold. After some idle chat about the biology of sleep, the board watched a demonstration of the company's user interface. Soon, the discussion turned to the thorny question of how much

23andMe will have to teach its customers about genetics to enable them to understand its offerings. "If we can get them to understand LD, that'll be an accomplishment," Avey said, referring to "linkage disequilibrium," a fairly obscure term describing how some genetic variations occur more often than anticipated. No, said Daphne Koller, a Stanford computer scientist and 2004 MacArthur fellow. "This should be a black box. LD is just going to trip them up."

As it happens, because 23andMe is a Web-based company, it can do both, letting the genetics hobbyist geek out on the details while giving the novice a minimum of information. Still, the challenge here was palpable: Starting a personal genomics company isn't like starting a Flickr or a Facebook. There's nothing intuitive about navigating your genome; it requires not just a new vocabulary but also a new conception of personhood. Scrape below the skin and we're flesh and bone; scrape below that and we're code. There's a massive amount of information to comprehend and fears to allay before customers will feel comfortable with the day-to-day utility of the site. 23andMe's solution is to offer a deep menu of FAQs, along with some nifty animation that explains the basic principles of genetics.

But the startup is also careful not to overwhelm customers with foreboding information. Take its approach to monogenic conditions like Huntington's disease. For one thing, the company makes it clear that it is not in the diagnostic business and therefore doesn't provide specific genetic tests for specific diseases. But even if 23andMe wanted to, the SNP technology doesn't allow it, since many of the 1,400 monogenic conditions are diagnosed using techniques other than SNP testing. The BRCA1 and BRCA2 mutations that carry a high risk for breast cancer, for instance, are not SNPs but more complex defects that show up only in a test that sequences the entire gene. Similarly, the test for Huntington's looks for repeats of a certain nucleotide sequence, rather than single-letter variations. Given the rarity of such conditions, it would be cost-prohibitive to include these tests in a \$1,000 run.

In other circumstances, the science is evolving so fast that 23andMe must invent a methodology as it goes. Take the essential task of calculating a customer's genetic risk for a disease, which the company delivers under its Odds Calculator. For a condition like type 2 diabetes, at least eight different SNPs have been correlated to the disease. Research among people of European descent has found that each of those SNPs has a slightly different effect — a variation of rs4712523 can increase one's risk by 17 percent, while a variation at rs7903146 can decrease risk by 15 percent. To crunch these numbers and determine one person's risk factor, 23andMe has opted to multiply the risks together. But a competing school of thought argues for adding the risk from SNP to SNP. The two approaches can result in wildly different tallies. "A lot of this is unknown. It's totally experimental," Wojcicki told me a few weeks before the science board meeting. "No one has looked at all eight diabetes markers together. They've all been identified individually, but they don't know exactly how they work together. So we've tried to make that clear."

All the ambiguity is indeed clear. There's no lack of caveats and in-context explanations on the site counseling customers to be cautious. In fact, the board at times even urged the company to hedge less and embrace the technology's gee-whiz factor, including uncertainty, more decisively. George Church, the Harvard geneticist who pioneered the sequencing techniques behind the Human Genome Project, sketched out a scenario: When a new study reporting a genetic

association with a disease shows up in *The New York Times*, people are going to log on to 23andMe that morning and check to see whether the genetic marker in question is in their results. "People are going to wonder if you've got them covered," Church said. "And the answer better be yes."

In fact, that answer depends on the DNA chip that 23andMe uses to scan customer genomes. The company outsources that work to Illumina, the chip's developer. In its lab, Illumina extracts DNA from saliva and disperses it across a 3- by 1-inch silicon wafer studded with more than 550,000 nanoscopic protein dots. Each dot detects a different SNP; more than half a million dots, strategically distributed across the human genome, cover a meaningful swath of anybody's DNA.

But it's possible that new research could turn up an association with a SNP that the 23andMe scan doesn't look for. And by definition, genotyping is a strategic, rather than an exhaustive, catalog.

The real endgame, therefore, is whole-genome sequencing, where you don't have to hope that you're covered — you'll know it. With whole-genome sequencing, all 3 billion base pairs of DNA will be identified: a complete library of your genetic code. As with DNA chips, sequencing technology is getting faster and costs are dropping. The Human Genome Project spent nearly \$3 billion to sequence the first human genome. Sequencing DNA co-discoverer James Watson's genome cost just under \$1 million; Craig Venter, who has already sequenced his genome at least once, is now spending about \$300,000 to have it read again. Prices are expected to fall even more rapidly now that the X Prize Foundation has offered a \$10million award to the first team to sequence 100 human genomes in 10 days for less than \$10,000 each.

At the board meeting, as talk turned to whole-genome sequencing, the energy in the room picked up. "This is absolutely the future," said Michael Eisen, a computational biologist at UC Berkeley. "It's exactly what the company should be doing as soon as possible."

"We will," responded Wojcicki, who then offered a juicy detail to the board. "We already have 10 people lined up and willing to pay \$250,000 each for their whole genome. It's definitely something we want to do, maybe even in '08."

"George, how much will \$250,000 get you?" Eisen asked Church, who's also on the X Prize advisory board. "How good a sequence would that be?"

"As good as Watson's," Church said. "At least as good."

Pushing the science forward is also a key part of the 23andMe business plan. As the company builds up its roster of customer genotypes, and later whole sequences, it gains a treasure trove of data that in turn can drive further research. On signing up, customers agree that their data, though still confidential, may be made available for scientific purposes. As the pool of participants grows, the startup hopes to forge partnerships with academics and advocacy groups that focus on specific conditions. Already, the Parkinson's Institute is working with 23andMe on a study of Parkinson's disease. Similarly, 23andMe is talking with Autism Speaks, an advocacy group,

about initiating research into autism — a disorder so complex that it will require the genetic information of many thousand research subjects to tease out potential associations.

This is also where a novel use of social-networking tools comes in. Wojcicki envisions groups of customers coming together around shared genotypes and SNPs, comparing notes about their conditions or backgrounds and identifying areas for further scientific research on their own. "It's a great way for individuals to be involved in the research world," Wojcicki says. "You'll have a profile, and something almost like a ribbon marking participation in these different research papers. It'll be like, How many *Nature* articles have you been part of?" (Social networking will be included in version 2.0 in a matter of months, Avey says.)

For the board, such enterprising approaches to research are part of the fun of 23andMe. But after a long afternoon in a stuffy conference room, even geneticists can tire of too much genetics, and the meeting wound down. As the group walked into the foyer, someone asked about the two Segways there. Soon enough, some of the world's most celebrated geneticists had hopped aboard and were taking turns racing around the office at top speed.

My risk for heart disease may be lower than average, but that doesn't mean my genome isn't primed for problems. Far from it. Variations of three SNPs double my risk for prostate cancer, leaving me with a 30 percent chance of developing it in my lifetime. Restless legs syndrome, a dubious-sounding ailment characterized by jerky twitches in the middle of the night, was recently associated with a particular SNP variation — and I've got it, raising my risk by 32 percent. And my risk for exfoliating glaucoma, a type of eye disease, is a whopping three times the average American's. While the average person has just a 4 percent risk, my risk factor of 12 percent means it's something to mind.

Scanning my spreadsheet, all the odds start looking more like land mines. An 18 percent risk festers for this potentially fatal condition, a 13 percent risk ticks for that debilitating condition, and somewhere out there looms a 43 percent chance for something I may survive but sure don't want. And suddenly I realize: I can try to improve my odds here and there — eat less steak, schedule that colonoscopy earlier than most — but I'm going to go somehow, sometime. I can game the numbers, but I can't deny them.

Think of it this way: Health is an equation, with certain inputs and outputs. With conventional medicine, that means some fairly basic algebra: the simple addition and subtraction of symptoms and causes, with treatments like pharmaceuticals and surgery on the other end of the formula. For most Americans, the calculation results in fairly good health, with a lifespan stretching into the seventies. With the advent of genomics, though, we have stumbled into a far more arduous calculus, one requiring a full arsenal of algorithms and vectors. It's a more powerful tool — but it's also a lot more complicated.

It's not just the matter of accounting for all of our genetic markers and computing the attendant risk. That's just the start of it. Real personalized medicine must take into account traditional environmental factors, like smoking and diet and exercise. It also must consider the legion of pathogens out there, each with its own genetic quirks — not only the conventional ones of infectious disease but also the emerging class of viruses that seem to influence conditions from

certain cancers to ulcers to obesity. Then there is the microbiome, the trillion-cell ecosystem of microbes that lives inside all of us, contributing to our health in largely mysterious ways. Oh, and save a piece of the equation for epigenetics, changes to the ways genes function without changes in the actual gene sequence. They contribute to our risk for common diseases such as cancer, heart disease, and diabetes.

Finally, leave a big blank spot for chance. No matter how much we learn from our genome, no matter how much it explains about us, randomness is always a looming factor in any health equation. Consider one behavior that is strongly associated with bad health — smoking. Everyone knows smoking is the single worst choice most people can make for their health. Yet the truth is that about a quarter of long-term smokers will not die of a smoking-related disease. Fate doesn't always work in our favor, though: Account for every known risk factor for heart disease — from high cholesterol to smoking to high blood pressure — and that explains only half the cases of the disease in the US. In other words, I can bank on my genes and live in the most optimal way... and still die of a heart attack.

Mathematics isn't just a metaphor here. All of these variables are being broken down into data by scientists, and each data set is being scrutinized in an effort to quantify its impact on health. So let's make the leap of faith. The science is there, the data has been crunched, and it's all clear: Your genome is telling you that you face an elevated risk for certain diseases. What do you do? First, you likely go to your doctor (and let's assume she is one of the mere 800 MDs nationwide who has some training in genetics, so that she can actually make sense of your information). She considers your elevated risk and recommends some specific changes to your lifestyle. Will that work?

It might, if you act on that advice. But odds are you won't. In 1981, the National Institutes of Health completed a 10-year study that stands as the largest effort in scientific history to track behavior change. Starting with a pool of more than 360,000 Americans, the NIH set up centers around the country to study how well people would follow behaviors to alleviate the risk of heart disease. The subjects received personal counseling and support to help them stop smoking, eat better, and lose weight. At the study's end, though, 65 percent of the smokers still had the habit, half of those with high blood pressure still had it, and few had changed their diet at all. Subsequent studies have shown the same thing: Changing behavior is hard.

Luckily, there will be drugs tailored to work more effectively with our genetic quirks. These pharmacogenomics already exist: Herceptin specifically targets breast cancers that are caused by a growth protein from the HER2 gene, for instance, and more are in development. But taking a drug for several years, even one tailored to your DNA, can create a new set of disease risks and initiates a new trajectory of calculations.

The question becomes, then, whether you want to embark on this path of oddsmaking in the first place. Many individuals won't want to know what their genome has in store. Others will, only to join the worried well — those who live in fear of fulfilling their genetic destiny. And, of course, those genotyped or sequenced at birth won't have that choice; it'll already have been made for them.

Still, Wojcicki is onto something when she describes our genome as simply information. Already, we calibrate our health status in any number of ways, every day. We go to the drugstore and buy an HIV test or a pregnancy test. We take our blood pressure, track our cholesterol, count our calories. Our genome is now just one more metric at our disposal. It is one more factor revealed, an instrument suddenly within reach that can help us examine, and perhaps improve, our lives.

[http://www.wired.com/print/medtech/genetics/magazine/15-12/ff\\_genomics](http://www.wired.com/print/medtech/genetics/magazine/15-12/ff_genomics)



## Afghanistan: What is Required

16/11/2007



**Amir Taheri was born in Iran and educated in Tehran, London and Paris. Between 1980 and 1984 he was Middle East editor for the *London Sunday Times*. He has been a columnist with *Asharq Alawsat* since 1987**

In every war there comes a time when victory chooses its camp. That choice may take some time before it becomes apparent to those involved, but the more perceptive recognise it as soon as it appears on the horizon.

Almost exactly six years after the start of the war that toppled the Taliban in Kabul, victory appears to be choosing the camp of the new Afghanistan symbolised by its elected president, parliament and government.

Many facts point to this shift in the fortunes of war.

- \* The Afghan economy is picking up, having registered double-digit growth rates for the past two years. This shows that the Taliban and their Al Qaeda allies are less able to disrupt development projects and private business in all but four of the nation's 30 provinces.
- \* The central government's administrative presence has expanded rapidly, now covering some two-thirds of the territory. The Taliban's campaign of murdering government officials has failed to stop the central government from rebuilding the civil service at all levels.
- \* Starting from almost zero, the country's education and health services have been rebuilt and now cover almost half of the population. The Taliban and their Al Qaeda allies have failed to destroy public services by killing teachers, doctors and nurses.
- \* Afghanistan has held a number of elections to approve a new constitution and elect a parliament and president. Despite exceptional brutality, efforts by the Taliban and Al Qaeda to disrupt the process have failed. The Afghans have developed a liking for elections, a fact indicated by the steadily rising number of voters successive polls.
- \* The new Afghan army has been built to an unprecedented strength of 125,000 men of which at least a quarter consists of battle-hardened units. The new police force of some 30,000 is also beginning to make its presence felt, at least in some larger urban areas.

\* Perhaps the most important reason for optimism is that the Taliban appear to have lost part of their constituency that consisted of the most conservative clerics, Pushtun tribal chiefs, and lumpen elements in a few cities such as Kandahar. The overwhelming majority of the traditional intellectual elites who had sided with the Taliban have broken with it and, in many cases, joined the new mainstream.

Despite all the encouraging news, it would be a mistake to assume that Afghanistan is out of the woods. Victory may have chosen its camp but, fickle as it is, it may well have a look at what it has chosen and, not liking it, change its mind again.

There is, of course, no way in which the Taliban might ride back into Kabul as victors. They have lost the support of Pakistan that initially helped them crush weaker adversaries in the mid-1990s in the context of a lopsided civil war.

It is unlikely that President Pervez Musharraf, or whoever succeeds him, would wish to revive a monster that threatens Pakistan itself.

In recent months, the Taliban have become increasingly dependent on the Islamic Republic in Tehran for both safe haven and geographical depth and material support.

Alliance with Tehran may enable the Taliban to fight a bit longer. But it will also make sure that at the crucial moment, the Iranian mullahs would be able to pull the carpet from under the feet of their Afghan counterparts. Tehran wants the Taliban to make life difficult for President Hamed Karzai's US-backed regime in Kabul. However, it does not want the Taliban to rule in Kabul, something that would be a strategic threat to Iran.

Although they cannot envisage victory, the Taliban could still fight for a stalemate in the hope that dramatic changes in other places, especially Pakistan, may alter the regional balance of power in their favour.

Two factors encourage Taliban that the war is not over.

The first is a sense of war fatigue manifested by almost all the European members of the North Atlantic Treaty Organisation (NATO) with troops in Afghanistan. In most cases, their presence is largely symbolic with contingents that seldom number more than 1000 men. Even then, only five NATO members are engaged in any actual fighting, with others content to show the flag in so-called peacekeeping tasks. Even the French, despite President Nicolas Sarkozy's much publicised pro-American sentiments, plan to downgrade their participation in the Afghan war. War weariness in the United States, Britain and Canada may well make it impossible for NATO to maintain the present troop levels within acceptable rotating schedules. A change of government in Australia could also be good news for the Taliban.

The second factor that might undermine victory from definitely choosing its camp is the confusion that marks the UN-led mission in Afghanistan.

The key condition for winning a war against insurgents is to have a unified command and control system capable of deploying resources to maximum effect where and when needed.

In Afghanistan, however, we have four separate command structures.

The first, provided by the United Nations, has not come out with anything resembling a coherent strategy. The UN appears to be looking for what the French call the beau role by engaging in humanitarian activities, leaving others to do the dirty work. Alongside, NATO has its own separate command and control system that, though nominally under the UN, seldom coordinates with it. However, even the NATO command is not unified. The US has its own separate command and is fighting a distinct war in southeastern Afghanistan. Several NATO members, notably Germany, France and Holland, refer to command structures in their own capitals rather than on the ground in Afghanistan.

To complicate matters, the European Union has also set up its distinct shop and pursues ambitions that, at times, clash with those of the US, NATO and the UN. Then there is the Afghan government itself that, anxious to assert authority, is engaged in a political war with its foreign allies.

What Afghanistan needs is a unified strategy pursued by a unified command with the participation of a coalition of the willing. Military gains must be translated into political and economic realities to consolidate the victory that has already been won. In a unified strategy, the focus would remain in destroying the Taliban and Al Qaeda rather than getting involved in tangential activities with PR appeal.

NATO would need to maintain present troop levels for at least another three years to allow the new Afghan army to test its units in seizing and holding territory.

The question is: where would those troops come from if a majority of NATO members succumb to war fatigue?

One idea is to seek help from Muslim countries that have signed accords of association and cooperation with NATO. As the only Muslim member of NATO, Turkey is already making a major contribution and might be able to encourage other Muslim nations to help. However, facing terrorism from PKK bases in Iraq, Turkey might not be inclined to help allies that refuse to help it remove that threat from its own borders.

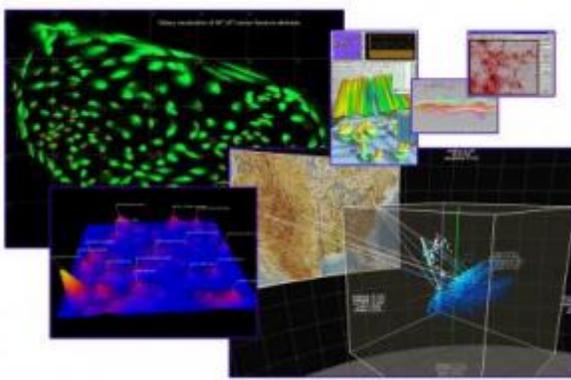
As always in politics, everything depends on everything else!

<http://www.asharqalawsat.com/english/news.asp?section=2&id=10885>

# ScienceDaily

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## Google Meets Sherlock Holmes



Scatter plots, 2-D shapes, rotatable 3-D clouds, animation -- these and other techniques are being explored to help analysts see clues in mountains of "fuzzy" data. (Credit: DHS S&T)

*ScienceDaily* (Nov. 19, 2007) — Soon after 9-11, Americans wondered aloud: How did our guardians miss the clues? Suspects on watch lists had moved money in curious ways.

"Chatter" had risen in recent months. A visitor to the country had offered cash to learn how to fly--but not land--a jetliner. In hindsight, these telltale nuggets provided evidence of the terror to come.

Or did they? Most such nuggets were buried in a landslide of data arriving faster than analysts could make sense of it. A day's take would fill more than 6 million 160-gigabyte iPods. Moreover, like people, the nuggets sometimes disagreed. And like a story told and retold, their message changed, sometimes imperceptibly.

Finally, most nuggets are cast in unstructured, "fuzzy" data. The same face--or is it"--may appear in three surveillance videos. Someone in Florida is snapping up potential makeshift detonators on eBay. Such clues, like most, don't come conveniently packaged in a tidy spreadsheet or searchable text; they must be inferred from photos, videos, voice.

To thwart the next 9-11, analysts must meld the encyclopedic eye of Google with the inductive genius of Sherlock Holmes.

Late last century, Edward Tufte catalogued ways to display data that were either structured (train schedules) or similar (death rates). Today, researchers at the DHS Science and Technology Directorate are creating ways to see fuzzy data as a 3-dimensional picture where threat clues can jump out.

The field of visual analytics "takes Tufte's work to the next generation," says Dr. Joseph Kielman, Basic Research Lead for the Directorate's Command, Control and Interoperability Division. Kielman advises the National Visualization and Analytics Center, based at Pacific Northwest National Laboratory, and its university partners, called the regional centers.

The centers' interdisciplinary researchers are automating how analysts recognize and rate potential threats. Mathematicians, logicians, and linguists make the collective universe of data assume a meaningful shape. They assign brightness, color, texture, and size to billions of known and apparent facts, and they create rules to integrate these values so threats stand out. For example, a day's cache of video, cell phone calls, photos, bank records, chat rooms, and intercepted emails may take shape as a blue-gray cloud (picture, lower-right). If terror is afoot in L.A. and Boston, those cities are highlighted on a U.S. map (picture, center).

A month of static views might be animated as a "temporal" movie, where a swelling ridge reveals a growing threat.

"We're not looking for 'meaning,' per se," Kielman explains, "but for patterns that will let us detect the expected and discover the unexpected." Neither the researchers nor the analysts, he says, need to understand the terrorists' language--no small advantage, given the shortage of cleared linguists.

It will be years before visual analytics can automatically puzzle out clues from fuzzy data like video, cautions Kielman: "The pre-9/11 chatter didn't say, 'We're going to plow airplanes into the Twin Towers.' To correlate these facts, you must get relational," connecting screen names with bank records, bank records with faces. How researchers will get there remains an unwritten story. But with each chapter, the plot thickens.

*Adapted from materials provided by US Department of Homeland Security - Science and Technology.*

<http://www.sciencedaily.com/releases/2007/11/071114095244.htm>



## How Does the Brain Recognize a Face?

**The smile of the Mona Lisa may remain forever ineffable, but at least now science can measure the difference between the real thing and its many imitations.**

November 13, 2007 – A team of neuroscientists including Irving Biederman, the holder of the Harold Dornsife Chair in Neurosciences in USC College, say they can predict with near-perfect accuracy whether two faces resemble each other enough to fool a human observer.

Their study provides rare insight into the hard rules guiding one of the most subjective of processes.

The researchers presented their results Nov. 6 in San Diego, at the annual meeting of the Society for Neuroscience. The study used a face recognition computer model, previously developed by Christoph von der Malsburg of the USC Viterbi School of Engineering and the College, to try to understand how human brains recognize faces.

“We knew that the model could do a good job at matching one image of a face to a different picture of the same person,” Biederman said, “but we did not know whether it was doing it in a manner that mimicked the way people were doing it. “Our experiments showed that if the model computes two faces to be very similar, then people will have a hard time telling the difference between the two faces.”

The research group, which included lead researcher Xiaomin Yue, a 2007 alumnus of the College’s psychology doctoral program who is now a research fellow at Massachusetts General Hospital, interpreted the consistent results as evidence that the computer model faithfully represents neural processes.

“It’s quite likely, or at least plausible, that the brain is doing face matching this way,” said Biederman, professor of psychology and computer science.

To test the model, the researchers showed a dozen volunteers a triangular array of three faces for a half a second. One of the lower faces was an identical match to the upper face, while the similarity of the non-matching face, as measured by the model, varied slightly.

Biederman said the model “predicted almost perfectly” which faces would stump the study subjects, leading them to make slow and incorrect decisions. “All subjects showed exactly the same pattern,” he said.

The model builds on previous studies of the first area in the visual cortex to receive signals from the optic nerve. Known as V1, the area contains hundreds of millions of neurons tuned to detect contrast between light and dark.

Each neuron fires only when its simple preferred feature — say a white bar on a black background — appears in a unique location, at a unique angle and at a unique size. This pattern of neuronal firing then drives networks of neurons in later stages that represent faces, objects and scenes.

These later networks allow the brain to recognize objects even if they appear in a different orientation or with a different direction of illumination.

This ability comes at the expense of some of the data acquired by V1, including details useful in facial recognition, Biederman said.

For that task, which demands very fine discrimination, Biederman and others believe that the brain reverts to a V1-type of image analysis, though at a risk of error if the viewing conditions change.

For example, humans find it almost impossible to recognize a face if it is upside down, or lit from an unfamiliar angle, or viewed as a photographic negative. Not so with objects.

Biederman said the study also helps explain why many beginning artists struggle to represent objects believably.

“The hard part about learning to draw is not drawing the object,” Biederman said, meaning that the artist must focus on V1-acquired properties, such as reflectance, orientation and graininess that the brain automatically subordinates.

Biederman, who has explored aesthetic theory with his research on visual perception, will investigate the conservation of aesthetic principles in ancient cave art and in remote tribes in two upcoming papers.

Source: USC College

<http://www.physorg.com/news114192637.html>



## Israel, the hope of the Muslim world

By Spengler, November 20, 2007

The state of Israel embodies the last, best chance for the Islamic world to come to terms with the modern world. Received wisdom in the foreign ministries of the West holds that relations with Muslims would be ever so much easier without the annoying presence of the Jewish state, which humiliates the Muslim world. Just the opposite is true. The Israeli presence in the territory of the ancient Jewish commonwealth, on land that once belonged to the Dar al' Islam, offers the single, slender hope for the future of the Muslim world, precisely because it constitutes a humiliation.

The premise of Western policy is to tread lightly upon Muslim sensibilities. That is an error of first magnitude, for Muslim sensibilities are what prevents the Islamic world from creating modern states. Islam cannot produce the preconditions for democracy in the Western sense out of its own resources.

Free elections in Muslim lands tend to hand power to fanatical despots. Why should that be true? The first premise of Western democracy, that the rights of the weakest and most despised citizens are sacred, stems from the Judeo-Christian notion of divine humility. The creator of the universe suffers along with his creatures, and bears a special love for the weak and helpless, a belief that appears absurd in Islam. Islam has no inherent concept of humility; it can only be imported to Muslim countries from the outside.

Democracy in its modern form is the almost exclusive province of Christian (and in the single case of Israel, Jewish) countries. I have argued that it is the Judeo-Christian experience of divine love that makes it possible for representative democracy to flourish, because imitation of God reverses the rights of the weak and helpless. "Almost exclusive" is the operative term, for democracy functions well in some Asian countries. Next to love is humility, which acknowledges the limits of one man to impose his will upon another. For example, Japanese culture contains no concept of divine love in the Christian sense, but it does know humility, thanks to the instruction of the United States during 1941-1945 and the succeeding occupation.

No concept of intermediate cause, or rational ordering of the universe, is to be found in mainstream Islam. Allah personally and directly orders every event, from the trifling to the grandiose. The Muslim submits to Allah, the absolutely transcendent ruler of the universe, in return for his mercy and beneficence. That is why Muslim faith hinges upon success. As I observed in a 2004 essay, "Horror and humiliation in Fallujah," the Muslim call to prayer begins:

Allah is the Greatest.

I bear witness that nothing deserves to be worshipped except Allah.

Come to prayer.

Come to success.

No injunction to "turn the other cheek" is found in the Koran, no reflection on how to learn from defeat. Something like the Book of Lamentations, which tradition attributes to the Prophet Jeremiah after the fall of Jerusalem, is unimaginable in Islam. Jeremiah tells defeated Israel, "It is good to wait quietly for the salvation of the Lord. It is good for a man to bear the yoke while he is young ... Let him offer his cheek to one who would strike him, and let him be filled with disgrace."

The words "humble" and "humility" occur rarely in the Koran, and in most cases (7:206 and 17:109) refer not to Muslims but rather to Jews or other conquered peoples, as in "And [the children of Israel] fall down on their faces weeping, and it adds to their humility", or "We sent [apostles] to nations before you then We seized them with distress and affliction in order that they might humble themselves." There are a few references to the virtue of being humble before Allah, but not one suggestion that it is good to show humility to other human beings. Nothing like Hannah's praise of YHWH, (I Samuel 2:28), "You save the humble, but your eyes are on the haughty to bring them low," occurs in Muslim scripture.

In the October edition of "First Things," I published an extended treatment of Franz Rosenzweig's view of Islam, now available online. [1] The great 20th-century Jewish theologian considered Islam not a revealed religion, but a species of paganism. In pagan society, he argues, the individual is completely absorbed by the collective, by reference to Aesop's fable of the aged lion and the fox:

People, State, and whatever else the societies of antiquity may have been are lion's caves before which one sees the tracks of the individual entering, but not leaving. In fact, the individual human stands before society as a whole: he knows, that he is only a part. These wholes, with respect to which he is only a part, these species, of which he is only a representative example, have absolute power over his ethical life ...

In the thoroughly organized State, the State and the individual do not stand in the relation of a whole to a part. Instead, the state is the All, from which the power flows through the limbs of the individual. Everyone has his determined place, and, to the extent that he fulfills it, belongs to the All of the State ... The individual of antiquity does not lose himself in society in order to find himself, but rather in order to construct it; he himself disappears. The well-known difference between the ancient and all modern concepts of democracy rightly arise from this. It is clear from this why antiquity never developed the concept of representative democracy. Only a body can have organs; a building has only parts.

The pagan state, Rosenzweig observes, considers the individual only as an extension of itself, not as the child of a higher power that stands above every state and culture. Pagan societies acknowledge no higher power than themselves. Their gods are an apotheosis of their own character. Allah, the absolutely transcendent ruler of the universe whose whimsy sets the spin on every electron at every moment, stands in sharp contrast to the Judeo-Christian God, whose humility in the form of love for his creatures sets inherent limits upon his powers.

In the democracy of the ancient Greek polis, or the assembly of the Germanic tribes, every individual stood in direct and immediate relation to the collective. The citizens or tribesmen voted in person in full public assembly. Modern representative democracy requires something else. The individual citizen chooses not only a party and its platform, but also a personality, who has the freedom to act on behalf of the voters at variance with an existing platform. The voters do not simply trust the tribe or state; instead, they trust an individual and give that individual proxy powers. They must trust that the body of such representatives will reach an agreement that takes into account their interest. Such a system simply cannot arise in a pagan culture, where conformity to the collective is a precondition of life.

Not for nothing did the founders of the American republic insist that its functioning was unimaginable without the Christian religion. The purely negative aspects of the American constitution, namely the balance of powers that protects minority interests, means nothing without transcendent trust in something higher than the elements that constitute the body politic. In pagan society there is family, clan, and state; there is no intermediate function of representation, because there is no transcendent trust. Pagans can have (and frequently do have) plebiscites or presidential elections that in a sense are real elections, but they never have a functioning parliamentary system.

As noted, there are non-Christian societies where parliamentary democracy flourishes, notably India. Hinduism is a subject from which I have steered clear, given the complexity of its history and variety of its practice. But the subject of humility is central to every manifestation of this religion, which honors the holiness of life to the point of forbidding the consumption of animals. Modern India, moreover, grew out of a centralized government established by the British, and received ready-made British laws and civil service, and with ease adopted the British model of parliamentary democracy. It was guided by leaders who lived as well as taught the Hindu concept of humility.

Japan is another exception. Buddhism in many forms teaches divine humility, but the Zen variety prevalent in Japan adapted itself well to the requirements of the samurai caste, which knew loyalty and submission, but not humility. After the suppression of feudal rights in 1868, Japan modernized without recourse to democracy. Only after its humiliation in World War II and the imposition of a democratic constitution by the American occupation did representative democracy come to Japan.

It is not clear whether Japanese culture will survive the great humiliation of 1945. As I observed elsewhere (“They made a democracy and called it peace” *Asia Times Online*, March 8, 2005),

the nuclear bombardment of Hiroshima and Nagasaki may have killed more than the few hundred thousand immediate casualties. It is possible that the attacks killed all the Japanese who ever lived, and all the Japanese who ever might live. In Japan's feudal past, humiliation was too terrible to endure, and suicide the only response. Japan's failure to reproduce may constitute a form of national suicide in response to national humiliation.

Admirers of the Jewish state praise it as an exemplar of democracy in the Middle East. Whether that is true or not is irrelevant to the concerns of the Muslims. Democracy is not a procedure that a country learns by example, like water management or road-building. It is adopted or not as an existential choice. For the Muslim world, what matters is not that Israel is a functioning democracy located in the Middle East, but rather that it is Israel that humbled the House of Islam.

Because success is central to Islam's promise, and the restoration of the Jewish commonwealth in its historic territory along with its ancient capital seems to validate Jewish scripture rather than the Koran, Israel offers an existential challenge to the Muslim world. Muslims will never accept the permanent presence of Israel unless compelled. But the bad news in this case is the good news, for if the Muslim world were to accept Israel's existence, the collective humiliation would be so profound as to force the concept of humility into Muslim political life. The best thing Western governments could do to foster democracy in the Muslim world, in fact, is to move their embassies to Jerusalem.

I noted elsewhere ("It's easy for the Jews to talk about life," September 18, 2007) that the presence of the state of Israel has had a decisive impact on Christian evangelization, especially in Africa. African Christians, as Philip Jenkins reported in his recent book on the Bible in the Global South, take the Hebrew scriptures seriously. [2] The apparent validation of God's promise to the descendants of Abraham gives them confidence that the New Testament's promise to Christians will be valid as well. What fosters Christian faith, by the same token, introduces doubt into Muslim faith. The humility that goes hand in hand with doubt - conceding that one's opponent might have a valid point - is what makes democracy possible in the first place.

Perhaps the Muslim world will respond to humiliation after the fashion of Japan. Iran's fertility rate has already fallen to a third of replacement, Prof Jenkins reported in the November 9 New Republic, even lower than Japan's. Even if that is the outcome, it is better than the alternative, namely a violent explosion over the remainder of this century. Washington's misguided effort to foster Islamic democracy might be the stupidest idea in the history of foreign policy. It began in the late 1970s with Jimmy Carter's backing for the Ayatollah Khomeini against the Shah of Iran. It may end with simultaneous civil war in Iraq, Pakistan, Afghanistan, Turkey, Lebanon and the West Bank. If that occurs, think of Rwanda and multiply by a thousand.

**Notes** 1. See Franz Rosenzweig and the Abrahamic Religions. "First Things" (October 2007).

2. "A new Jerusalem in sub-Saharan Africa," *Asia Times Online*, December 12, 2006.

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[http://www.atimes.com/atimes/Middle\\_East/IK20Ak01.html](http://www.atimes.com/atimes/Middle_East/IK20Ak01.html)

# NewScientistTech

## Laser fingerprint scanner does away with dusting

Belle Dumé, *NewScientist.com* news service, 16 November 2007

A portable device that could scan fingerprints in microseconds has been developed by scientists in India. The system, which works using a technique called optical coherence tomography, promises to be better than existing fingerprint detection methods since it does not require any chemical processing.

Optical coherence tomography (OCT) is like an optical version of ultrasound imaging. The technique is already routinely used in medicine, but has not had a forensic application until now. The technique provides a transparent 3D structural picture by sending light through the pattern of natural secretions left on a surface by a finger and combining the reflected beam with a "reference beam" produced by bouncing light from a laser off a mirror.

This produces an interference pattern at a photodetector – the same as those found in a digital camera – which can then be used to reconstruct an image of the original fingerprint.

### Better sensitivity

The new device, developed by Satish Kumar Dubey and Dalip Singh Mehta of the Indian Institute of Technology, New Delhi, is a "swept-source" OCT, which employs a rapidly scanning laser.

A key advantage of the design is that undesired reflections can be filtered out using a mathematical approach called selective Fourier filtering. This, in turn, helps the system detect fingerprints from surfaces that do not reflect light well, such as paper. Conventional techniques require chemical processing to enhance the contrast of fingerprint impressions.

The device currently uses a low frame-rate digital camera as its photodetector, so its response time is limited. "This can be improved using a high speed camera with smaller pixel size, which means the device will have the speed of a few microseconds," Mehta told **New Scientist**.

"OCT is a 3D instrument, hence excellent for the job," says Haida Liang, an expert on the technique, based at Nottingham Trent University in the UK. "The technique reported here is trying to image fingerprints with better sensitivity and clarity. There's certainly potential in using OCT for fingerprint detection and very little has been done on this application."

<http://technology.newscientist.com/article/dn12931-laser-fingerprint-scanner-does-away-with-dusting.html>



## RISE OF THE NEO-TALIBAN, Part 2

# 'Pain has become the remedy'

By Syed Saleem Shahzad, November 14, 2007

NAWA PASS, Pakistan border with Afghanistan - While I was waiting in a village mud mosque, several motorbikes emerged from the evening darkness along a dirt track.

Four strongly built men stopped in front of me and alighted, their faces flushed from their ride. They each gave me a hug, and their traditional Punjabi greeting was music to my ears after listening to a lot of Pushtu.

I asked the obvious question: "Are you Punjabi?" The concern on their faces was immediately noticeable. "No! We belong to this land and like many Afghans we were settled in Punjab [in Pakistan] and therefore learnt Punjabi and forgot Pashtu, but now we are back in our land and have learnt our language again," one of the men explained.

This is perhaps somewhat romantic. Although such Punjabis might have romantic ties with Afghanistan, they actually come from Pakistani Punjab. Before the partition of British India in 1947, Punjab was seen as a loyal colony of the British and their recruits fought against the Afghans. After partition, Punjabis were seen as usurpers who divided the Pashtun tribes in the name of a new country called Pakistan. To many Afghans, Punjabis are opportunists and while they claim to be Muslims, their culture is a blend of Hinduism and Sikhism.

Sadiq is not a commander: he cannot be, because whatever he might say about his ethnicity, for Afghans he is a Punjabi. I watched as he spoke fluent Pashtu to his Afghan comrades, moving from one group to another with a permanent smile on his face. Clearly, he is the natural leader of the diaspora of Punjabi guerrillas now in Afghanistan.

Sadiq was in the Lashkar-e-Taiba (LeT), a Pakistani jihadi group focused on the struggle to regain Indian-administered Kashmir. He was trained by Pakistan's Inter-Services Intelligence (ISI) to conduct guerrilla operations all across India. He knows how to generate resources and lead sorties.

He joined the Taliban in late 2004 as an ordinary fighter, but because of his skills he quickly rose through the ranks. He became a trainer and honed his men's battle skills. And although he is not a commander, he is more respected and important than many of them. He is the mastermind of all guerrilla operational plans in Afghanistan's Kunar Valley.

## **An emirate in the making**

I said my final prayers of the day and had my dinner. It was tolerably cold, and I sat back and by the light of a gas lamp watched and listened to tired guerrillas discussing their day.

"I was thinking before coming here, how do you say your Friday prayers in the battlefield - I noticed you did not say any today?" I started the conversation with Sadiq.

"First, we are all travelers, so Friday prayers are not compulsory. But most importantly, this region has been declared *darul harb* [enemy country], so Friday prayers are suspended until it becomes *darul Islam* [abode of Islam]," Sadiq replied.

I continued this discussion with Sadiq on prayers and the circumstances in which they are suspended and restored, and soon all the people in the mud hut had gathered around and the conversation turned to the new dynamics of the Afghan resistance.

So I launched a series of questions. "It is still not clear who is in whose command. What is the command of Gulbuddin Hekmatyar [leader of the Hezb-i-Islami]? Is [veteran Afghan resistance figure] Jalaluddin Haqqani under [Taliban leader] Mullah Omar, or is he commanding separately? Who does the Pakistan Taliban answer to? To Mullah Omar? And what are Pakistani jihadis up to?"

Sadiq smiled at the barrage of questions and responded with some breaking news, "Mullah Omar, the Taliban *shura* [council], al-Qaeda and the Pakistani Taliban have resolved this issue once and for all. Soon the mujahideen will announce the revival of a [region-wide] Islamic emirate, and after this - like all fighting groups gathered under a single command in Iraq - all commanders in Afghanistan will fall under the umbrella of the Islamic emirate.

"The Islamic emirate will govern [operations in] Afghanistan and Pakistan, and whether it is Gulbuddin Hekmatyar or any other, they will be under a single command and will not be able to defy the emirate because this is Islam," Sadiq said.

The pronouncement of an emirate would be a major development, and I jumped to my feet. "Are you sure that an Islamic emirate will be announced soon?"

"Yes, indeed," said Sadiq smiling.

"Sadiq, you know what this means? It would challenge both Pakistan and Afghanistan. Are the Taliban capable of doing this?" I asked.

"Of course we are," Sadiq replied calmly.

"How?" I asked.

"Three years ago, it was actually a dream, but now circumstances have enabled such an environment. Apart from North Waziristan and South Waziristan [tribal areas in Pakistan], the mujahideen used to move in Bajaur [Agency] and Mohmand Agency as if they were moving in

[the Pakistani cities of] Karachi or Lahore. We were terrified of being arrested and of the fact that somebody would be spying on us.

"We used to make secret trips to Afghanistan to conduct occasional raids. On the one side the Americans were after us, and on the other side our own Pakistani army was tracking us. We didn't want to fight the Pakistan army; after all, they are Muslims. We tried our best to avoid fighting them, and still hardly 3% of the mujahideen are fighting against them. However, Pakistan did not think the way we were thinking. They were more cruel and gruesome than the Americans.

"We had a companion who had fought alongside us in Kashmir. His name was Umer, and he was dead against fighting the Pakistani army. Whenever the military conducted operations, he used to desert his companions, saying he could not fight against Muslims.

"One day, he was arrested by the ISI. They hung him by one hand from a roof, and carved stars on his thighs with daggers. They humiliated him in all manners. When he was released, it was thought he would be a broken person.

"But now he is an advocate of jihad against the Pakistani army, bigger than anybody else. These sorts of incidents have turned the mujahideen into our camp. They understand they have been fooled in the name of jihad in Kashmir," said Sadiq, referring to Islamabad's de-escalation of fighting in the Kashmir Valley.

"In 2003, a gathering in Muredkey [the LeT's Pakistani headquarters] was an eye-opener to sincere jihadis. Hafiz Mohammed Saeed [chief of the LeT] introduced us to one Abdullah, a person wearing a prayer cap and a small beard. Many among us knew he was the head of the ISI's Kashmir cell.

"He addressed the gathering and made the point that the Kashmiri jihad could not achieve its objectives and that it was a lame duck. He advised the mujahideen to sit quietly at home until new circumstances developed. This sort of advice turned people into our camp, but the real revolution came because of al-Qaeda," Sadiq said.

"[Senior al-Qaeda leader] Abu Marwan al-Suri was killed [in May 2006] by the Khasadar force in Bajaur Agency. This is a force of peons. Had Marwan been killed by any elite commando force of the Pakistani army, we would not have been so saddened, but for a person like him to be killed by a third-rate force like the Khasadars, it was bad.

"He was traveling in bus when he was identified as an Arab and was asked to descend. He took out his revolver and warned the Khasadars that he was a mujahid and did not want to kill any Muslims, so they should let him go. The Khasadars did not listen to him. You know Arabs, they do not escape - they fight until their last - but he tried to flee to avoid fighting Muslims, and was killed.

"His body was photographed and the pictures were presented to the Americans with pride and the people responsible received medals. Every mujahid felt humiliated. Brother ... our blood is not so cheap to be played around with by any third-rate person. Mujahideen were full of rage.

They rose from their hideouts.

"Marwan's body became an inspiration. The aroma from his blood was a legend in Bajaur and his graveyard became a holy site. Reaction swept through Bajaur and in a matter of days the Khasadars' posts were wiped out and blown up. The army came to conduct operations, but was defeated.

"Our victories gathered all tribes around us. You know our biggest commander in Bajaur, Maulana Faqir Muhammad, was trained by the Pakistani army to resist the Soviets [in the 1980s] but after September 11 his brother was detained by the army. He was beaten to death.

"In 2005 the Taliban were limited to South Waziristan and North Waziristan and in Mohmand Agency there were only a few dozen of them, but now we number 18,000, thanks to the operations of the Pakistani army," Sadiq said, his face full of emotion.

"You asked me what makes us think we can establish an Islamic emirate," Sadiq said, and then recited famous Urdu and Persian poet Mirza Asadullah Baig Khan, who went under the pen name of Ghalib: "Pain has crossed its limits and has become the remedy."

"We have braved all their tyrannies. They cannot be more tyrannical than that. We are hardened and they are tired and now it is our turn and I promise that we will turn the tables on them soon," Sadiq said.

We were all tired, and went to bed, but my brain was racing so much it was a while before sleep came.

The next morning at breakfast we pick up on the same topic.

"Sadiq, whether it is right or wrong, don't you think that the new Taliban plans will create problems within the Pakistani army?" I asked.

"That does not matter. This battle cannot stop now. The mujahideen have been deceived so many times that now they have decided to fight the Pakistani army at all costs," Sadiq said, sipping his tea.

After a long pause, he continued, "You know, the Taliban are blamed for all the problems, but in actual fact it is America which will never allow a ceasefire between the Pakistani army and the mujahideen. The Americans will force the Pakistani army to fight against us and therefore this battle will continue," Sadiq said.

"Man, you are fighting against the army and blaming America," I taunted him.

"I will tell you why. The Americans know exactly how near we are to Islamabad and they are aware of defections in the Pakistani army, and they are also aware that only one or two defections at the level of colonel will mean that the mujahideen will get their hands on some batteries of missiles which can carry nuclear warheads.

"And they [Americans] know the moment the mujahideen get that, the game will turn in favor of the mujahideen both in Pakistan and Afghanistan, and then nobody will be able to stop our march. So the Americans want a big battle between the army and the mujahideen so that the end game will be that they can step in and destroy Pakistan's nukes under the pretext that the Pakistani army cannot protect them from the mujahideen," Sadiq said.

Shortly after breakfast, the Taliban said goodbye to me. On my way home, as I passed deserted checkpoints in Bajaur, I cast my mind back to the origins of the US-led "war on terror", the attacks of September 11, 2001.

Al-Qaeda carried these out with a particular aim - to invite the wrath of the American "cowboys" who would beat up Muslims to such an extent that a severe backlash would be generated. Six years have passed, and we have had the invasions of Afghanistan and Iraq (maybe Iran in the offing). Yet it might be in the tribal areas of Pakistan that the real showdown begins. I can just imagine the dance of jubilation Osama bin Laden and Ayman al-Zawahiri will do on the news of a fresh grand operation by the Pakistani army there - it will only breed more Taliban.

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[http://www.atimes.com/atimes/South\\_Asia/IK14Df04.html](http://www.atimes.com/atimes/South_Asia/IK14Df04.html)

# NewScientistTech

## 'Poor man's broadband' has a turn of speed

Tom Simonite, *NewScientist.com* news service, 18 November 2007

It's not often that you get to go faster by avoiding the superhighway, but soon students in Pakistan will be able to download big files faster by avoiding the internet.

Instead of using expensive broadband or slow, unreliable dial-up connections, students at Lahore University of Management Sciences (LUMS) will try out a new system, dubbed "poor man's broadband" (PMB). It allows computers to link to each other directly for faster downloads, and it works as long as at least one computer running the trial software has already downloaded the desired file from the internet. The system should also reduce the university's risk of overloading the bandwidth supplied by its internet service providers (ISPs).

PMB is a mixture of peer-to-peer (P2P) software - touted as the internet's future (*New Scientist*, 13 October, p 28) - and pre-internet techniques, whereby users dialed other computers directly to exchange files. It is based on P2P software called BitTorrent, which allows computers to talk directly to each other and swap chunks of files. The snag is that BitTorrent requires that all computers be connected to the internet to swap files - a luxury in Pakistan. So LUMS computer scientist Umar Saif tweaked BitTorrent to create the new system.

Saif's version allows computers to "gossip" about which PCs they have called in the past, and which computer had what files. Gossiping happens every time computers connect to make a transfer, ensuring the entire network is kept updated.

PMB users still surf the web as usual, but when they try to download a large file, the software checks its gossip logs to see if it can call another computer directly for a faster download. "Trials so far show this can be more than five times faster than the internet [alone]," says Saif.

The system will mainly help in the download of software patches and free educational materials, like MIT's Open Course Ware, says Saif, because they are large files likely to be found on local computers.

After the university trial, Saif intends to try a city-scale test and hopes to interest other countries with poor internet infrastructure. He is also in talks with PTCL, the largest ISP in Pakistan, about using his idea.

<http://technology.newscientist.com/article/mg19626305.900-poor-mans-broadband-has-a-turn-of-speed.html>

## **EurekaAlert!**

### **Researcher models effects of suicide bombing: results of crowd configurations**

#### **How people group in crowds can exacerbate, minimize injuries**

MELBOURNE, FLA., November 13, 2007—Recent research by Zeeshan-ul-hassan Usmani, a Florida Institute of Technology doctoral student and Fulbright Scholar, indicates that various crowd formations exacerbate or minimize injuries and fatalities in the event of a pedestrian suicide bomb attack.

His work was conducted through virtual simulation. It showed that the crowd formation experiencing the worst effects is a circular one, with a 51 percent death rate and 42 percent injury rate, thus reaching 93 percent effectiveness. A person that is in line-of-sight with the attacker, rushing toward the exit or in a stampede was found to be in the least safe position.

The safest way to stand or sit in a crowd, Usmani found, was in vertical rows.

“Zeeshan is one of the most talented students I have met. His ability to grasp and integrate distinct unrelated topics is impressive,” said Richard Griffith, Ph.D., Florida Tech associate professor and program chair, Industrial/ Organizational Psychology program.

His findings, though preliminary, may have implications for emergency response and counter-terrorism activities. He plans to continue the research, integrating several physical and social variables into the simulation. These include modeling physical objects such as landscape and furniture, and such social variables as crowd behaviors.

“There are many applications for this simulation, from special event planning to emergency response,” said Usmani.

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[http://www.eurekaalert.org/pub\\_releases/2007-11/fiot-rme111307.php](http://www.eurekaalert.org/pub_releases/2007-11/fiot-rme111307.php)



## Stopping Cars with Radiation

**A beam of microwave energy could stop vehicles in their tracks.**

By Brittany Sauser, Tuesday, November 13, 2007

Researchers at Eureka Aerospace are turning a fictional concept from the movie *2 Fast 2 Furious* into reality: they're creating an electromagnetic system that can quickly bring a vehicle to a stop.

The system, which can be attached to an automobile or aircraft carrier, sends out pulses of microwave radiation to disable the microprocessors that control the central engine functions in a car. Such a device could be used by law enforcement to stop fleeing and non-cooperative vehicles at security checkpoints, or as perimeter protection for military bases, communication centers, and oil platforms in the open seas.



**Zapping the bad guys:** Attached to the roof of this police car is a 200-pound electromagnetic system that can quickly bring an opposing vehicle to a stop. The system is six to eight feet long (antennae included) and almost three feet wide. It works by sending out pulses of microwave radiation that disable the microprocessors that control the central engine functions of a car. **Credit: Eureka Aerospace**

The system has been tested on a variety of stationary vehicles and could be ready for deployment in automobiles within 18 months, says James Tatoian, the chief executive officer of Eureka Aerospace and the project's leader.

To bring an opposing vehicle to a halt, the 200-pound device is attached to the roof of a car. The car's alternator serves as the system's power source, whose direct-current (DC) power feeds into a power supply. This generates a stream of 50-nanosecond-duration pulses of energy. These pulses are amplified to 640 kilovolts using a 16-stage Marx generator.

The 640 kilovolts of DC power are then converted into microwaves using an oscillator that consists of a pair of coupled transmission lines and several spark-gap switches. Finally, a specially designed antenna beams the microwave energy toward an opposing vehicle through a part of the car, such as the windshield, window, grill, or spacing between the hood and main body that is not made of metal. (Metal acts as a shield against microwave energy.)

The radiated microwave energy will upset or damage the vehicle's electronic systems, particularly the microprocessors that control important engine functions, such as the ignition control, the fuel injector, and the fuel-pump control. However, electronic control modules were

not built into most cars until 1972; hence the system will not work on automobiles made before that year.

The concept of disabling vehicles' electronic system with microwaves was first tested in 1997 by the U.S. Army using bulky and heavy military equipment. But the Eureka Aerospace system is only six to eight feet long (antennae included) and not quite three feet wide. "It is much more efficient and compact than anything previously used in military vehicles," says Tatoian.

The device's peak power output is two gigawatts, although the average power emitted in a single shot is about 100 watts. Each radiated pulse lasts about 50 nanoseconds. All the test cars' engines were shut off using a single pulse at a distance of approximately 15 meters, making the total energy output 100 joules, says Tatoian. His company is currently developing a more compact high-power microwave pulse system with the goal of disabling engines at ranges from as far away as 200 meters.

"I have no doubt that if you set up a microprocessor and get a high-powered, well-focused beam of energy on [a car], you can disrupt its operation," says Peter Fisher, a professor of physics and the division head in particle and nuclear experimental physics at MIT. But to be able to deploy such a system safely will take some work, he says.

Imagine if a police officer is in a high-speed chase near a shopping mall and turns on one of these systems to stop the perpetrator: a lot of elevators have microprocessor controls, so if the officer is pointing the device in the direction of the mall, he or she could end up trapping 12 people in an elevator, says Fisher. Many other electronic systems, such as an automated teller machine or a security system, could also be disrupted.

Furthermore, Fisher cautions that, while the system may seem like an easier and more efficient solution than spike strips, it could still cause a huge accident if a car is disabled and a driver loses steering control. The system could pose a safety concern as well: radiation can burn human skin, and microwaves have long been suspected of being a cancer-causing agent.

At the moment, the most practical application for the system would be in the U.S. Army or Marine Corp, for perimeter protection of areas that are generally remote, says Fisher. Initial funding for the project came from the U.S. Marine Corp, but now Eureka Aerospace is looking to other governmental agencies for financial support as the company continues to work to make the device smaller, lighter, and more efficient. (Tatoian says that details regarding future work with the military are confidential.)

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## Survivors recall Baghlan bomb horror

By Alix Kroeger, BBC News, Baghlan, Afghanistan, November 14, 2007

The lane leading to the Baghlan sugar factory is lined with trees. All of them have been painted white at the base, but one is now blackened.



This is where a suicide bomber detonated explosives last week.

In all, around 70 people died here. More than 100 people were injured.

The bomb targeted a delegation of MPs, but most of the victims were schoolboys, there to welcome the visiting dignitaries.

The explosives were laced with ball bearings to inflict the maximum damage. In the confusion after the blast, bodyguards working for the MPs opened fire.



### The attack was called the worst in Afghanistan since 2001

The scene of the blast is still the focus of local attention. When we arrived in Baghlan, north of Kabul, survivors and the bereaved clustered round us in minutes, eager to tell their stories.

Mahmad Jaweid, 15, was on crutches. He was one of the walking wounded - one of the lucky ones.

"Our teacher brought us here to welcome the MPs who were visiting. I heard an explosion, but I didn't know how many people were injured," he said.



### Most of the injured were schoolboys gathering to greet the MPs

"After five minutes, the guns began firing. I didn't know who was shooting so I ran away to the guard at the end of the street and then to the bazaar in town.

"My leg was injured, so people took me to the hospital."

Shafiqullah, 18, lost two of his brothers in the blast. One of them was 10, the other 11.

"When I heard the bomb blast, we ran to the scene. Lots of people were crying and shouting and I saw my brothers lying over there on the ground.

"Both of them were dead. When we saw they were dead, my father carried one of my brothers away, and I took the other one."

### 'Enemies of Afghanistan'

After 30 years of war and conflict, Afghans have had to get used to violence. But this bombing has shocked the country profoundly.

Partly because of the high number of deaths, partly because so many of the dead were children. And partly because no-one has claimed responsibility.

Many people blame what they call "the enemies of Afghanistan" - a phrase that can cover the Taleban, other insurgents or the factions led by various warlords. But they also blame the government, for failing to protect them and their children.



**Mohammad Fahim, teacher**

Waladaji Barakat, a farmer, was at home when a neighbour came to tell him about the bomb. One of his sons had been killed and another injured.

"They told me my son's body was at the mosque, so I went there, but when I found him, I didn't believe it was him. So I went to the hospital to see if he was there but I couldn't find him," he said.

"I went back to the mosque and when I washed his face, I saw that it was my son. So I took his body home and went to find my other son, who was injured."

He said he would continue to send his five other sons to school once the period of mourning was over and the school had reopened. But one of his neighbours said he was withdrawing his children.

And all of them agreed they would never send their children to greet visiting officials again. They did not trust the government to protect their children from attacks.

### Teacher shortage

But whether the school will be able to reopen is unclear. Five of its teachers were also among the dead. Since 2001, and the fall of the Taleban, the number of schools in Afghanistan has skyrocketed. In a small town like Baghlan, finding so many qualified teachers will not be easy.

For Mohammad Fahim, one of the teachers who was unharmed, the suicide bomb meant the loss of five of his colleagues. One of them was also his father.

"I have a suggestion for the government of Hamid Karzai," he said.

"Representatives of the government should not use bodyguards who have no experience and no judgment. When the bomb went off, the bodyguards opened fire and killed some of our young people."

He pointed out two school exercise books still lying on a dusty wall opposite the spot where the bomb went off.



### **Ribbons mark the place where the bomb exploded**

Leafing through them, he said they were from a geography class; they belonged to a 16-year-old pupil. He would never claim them now.

There were also ribbons in the colours of the Afghan flag - red, green, black and white - tied round a nearby tree. No other visible marks remained.

Rumours that it might have been a roadside bomb, a landmine or a rocket attack circulated in the immediate aftermath of the explosion.

But there were no marks on the pavement. And all the eyewitnesses we spoke to confirmed that it was in fact a suicide bomb.

### **Unclaimed attack**

Dr Ahmad Zia Muzhda, who treated some of the wounded, wanted the government to make public the results of its investigations as soon as possible. But he was certain of one thing - the bomber did not come from Baghlan.

"The man who did this was not from our province," he declared. "Nobody wants to kill their own sons or the sons of this province. No-one would want to destroy his home by his own hand."

But the truth is that nobody really knows. The Taleban have denied responsibility. So have the Hezb-e Islami faction led by Gulbuddin Hekmatyar, which has a strong base in Baghlan province.

As well as the government in Kabul, anger has been directed at the provincial governor and the police commander.

Neither was in Baghlan at the time of the attack.

The governor of Baghlan refused to speak to us. The police commander, Maulana Abdurrahman, defended his absence, saying he was at a seminar in Mazar-e-Sharif.

He was among those who blamed the "enemies of Afghanistan".

"If they attacked the army or the politicians, we'd say these are enemies of the government," he argued.

"But by attacking the students, they attacked all the Afghan people. They are the enemies of the Afghan people, and of course they are terrorists."

Outside the commander's office, a man with a video camera showed us some footage. He was a police officer who had been filming the MPs' arrival when the bomb went off.



**Victim Mustafa Kazimi was a prominent opposition figure**

The pictures showed Mustafa Kazimi, the most prominent of the MPs, striding along the lane and being handed a bunch of flowers by one of the pupils.

Then there was an explosion. A couple of minutes later, the tape showed a man holding up what he said was the head of the suicide bomber.

Cmdr Abdurrahman did not want to say whether he thought there would be other suicide attacks in Baghlan in the future.

"Do you know of any suicide attacks which have been prevented?" he asked, intending the question to be rhetorical.

In fact, there had been one in the neighbouring province of Kunduz, just the day after Baghlan.

A suicide bomber had blown himself up before reaching his intended target when he realised he was being followed by a secret policeman.

The policeman and one other person suffered minor injuries. The only person to die was the bomber.

### **Milestone of violence**

At a building next to the Baghlan sugar factory, a tattered grey mailbag held some of the objects recovered from the scene. There were sandals, a policeman's cap and a UNICEF exercise book.

The UNICEF logo was almost obscured by the blood that had dried on it.

The man who showed us the bag said they would bury the objects in a specially dug pit. A white flag would be put up to remember the innocence of the victims.



**Unclaimed belongings will be buried under a white flag**

The political shockwaves of the Baghlan blast continue to ripple out.

On Monday, the Afghan parliament said the weakness of the authorities was the main obstacle to improving security in the country.

Since the insurgency began two years ago, suicide bombings have become almost commonplace in Afghanistan.

But Baghlan marks a new milestone of violence. One many Afghans wish had never been reached.

[http://news.bbc.co.uk/2/hi/south\\_asia/7094434.stm](http://news.bbc.co.uk/2/hi/south_asia/7094434.stm)

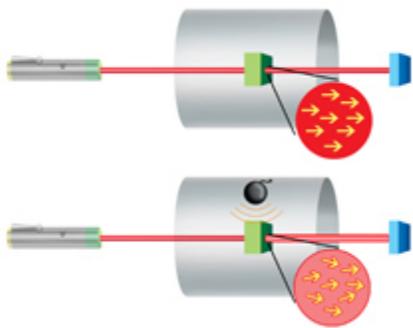


## Tiny, Sensitive Magnetic-Field Detectors

Arrays of cheap magnetic sensors could detect improvised explosive devices.

By Katherine Bourzac, Friday, November 16, 2007

Researchers at the National Institute of Standards and Technology (NIST) have developed a new type of magnetometer--or magnetic-field detector--that rivals the sensitivity of its predecessors but is small and cheap, and uses very little power.



**Shrinking sensors:** At top, metal atoms inside a silicon cube (green) are aligned (arrows) with light from an infrared laser shining onto a detector (blue). At bottom, in the presence of a weak magnetic field--emitted, for example, by a bomb--the atoms are shifted out of alignment and can now absorb light from the laser. *Credit: Loel Barr*

Magnetometers have a wide range of potential applications: where there is an electrical current, there is a magnetic field. Measurements of magnetic fields can reveal information about the electrical activity of the human heart and brain, the chemical identity of a spinning atom, or simply the presence or absence of metal. Because of their small size and sensitivity, the new sensors promise to improve detection of bombs and fetal heartbeats, and could be incorporated into future magnetic resonance imaging (MRI) scanners.

The new sensor, developed by NIST physicist John Kitching, consists of a laser, a cell containing vaporized metal atoms, and a light detector. When the metal atoms are illuminated by the laser, they align such that they don't absorb any of the light. The presence of even a very weak magnetic field, however, disrupts their alignment, and they absorb some of the light. This change is recorded by the detector.

Other researchers have made similar magnetometers, but Kitching and his team used microfabrication techniques to miniaturize the vapor cell, which in their device consists of a cubic millimeter of silicon. The laser is an infrared diode similar to those in CD drives, so all three components can be mounted on silicon chips, making them easier to work with. For applications such as the detection of improvised explosive devices or unexploded ordnance in minefields, the small size and low power consumption of the NIST sensors could make a big difference. The sensors could be grouped in arrays, making it possible to gain more data in a given amount of time. Commercially available laser-based magnetic detectors are the size of soda cans, require 20 watts of power, and cost \$20,000 each, so grouping them in arrays is impracticable.

Remediation workers use these large sensors to detect unexploded land mines and other weapons in former battlefields, but it's a "tedious procedure," says Mark Prouty, president of Geometrics, a San Jose, CA, company that makes magnetic sensors. The heavy sensors must be carried back and forth across a field, then carried back to an office, where magnetic data is synthesized with GPS data to make maps. Then the workers must go back to the field with the maps to dig up the weapons.

With an array of smaller sensors, it would be possible to "gather data in a snapshot and dig [weapons] up in the field," says Prouty.

The detection of improvised explosive devices is also a big problem for the military, says Prouty. It's difficult to detect these bombs with individual magnetic sensors because "everything shows up, including the vehicle the sensor is mounted on," he explains. Single sensors take point measurements; they can detect a metal-containing object like a bomb but can't give any information about its location or shape. An array of magnetic sensors could "give an answer on the spot," says Prouty.

Magnetic measurements are also used to study the brain and the heart. Nerve activity in the brain generates very weak magnetic fields--about 10 orders of magnitude smaller than the earth's. Measuring this weak biomagnetism requires highly sensitive magnetic detectors called SQUIDS, which in turn require superconducting materials. The most sensitive SQUIDS must be cooled to within a few degrees of absolute zero with liquid helium; they cost about \$2 million.

Kitching's magnetometers are nearly as sensitive as SQUIDS and can operate at room temperature. He says that they are currently sensitive enough to measure magnetic fields from the heart but not from the brain. "Fetal heart monitoring is getting a lot of attention in the medical field" but is difficult because it's not possible to place electrodes directly on a fetus in utero, says Kitching. "Electrical fields don't get to the surface unaffected [by the mother's tissues], but magnetic fields do," he says.

David Cohen, who made some of the first measurements of biomagnetism in the 1960s, says that Kitching's magnetometers "may get to the point where you can measure the heart," but he is skeptical that they will be used to study brain activity. He doubts that a device using the NIST sensors to detect biomagnetism would end up being any cheaper than those that rely on SQUID.

Another potential use for the sensors is in future MRI scanners. "For noninvasive biological measures, this could be a really interesting thing," says Yael Maguire, who, before founding ThingMagic, in Cambridge, MA, worked on miniaturizing nuclear magnetic resonance detectors, a technology similar to MRI. MRI currently requires its own room, specialized technicians, and a large, strong magnet. "The cost of access to the machines" is a problem with MRI, says Maguire. (See "Better Pictures of Proteins.") Highly sensitive, cheap magnetometers like Kitching's could be incorporated into future MRI scanners, enabling them to use smaller magnets, bringing their cost down, and potentially making them portable.

But such clinical applications are many years away. Right now, Kitching says that he's studying the trade-off between the size and sensitivity of the magnetometers and is also designing chips to carry them.

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