PUBLIC HEALTH

Cabin fever

Engineers are developing computer models to keep airplanes from becoming disease incubators.

AN AIRBORNE BOEING 767 JET contains 3.1 million parts, 90 miles of electrical wiring, about 200 passengers—and an unquantifiably high number of germs and viruses. Isolated 30,000 feet in the air, a plane's cabin is a fecund Petri dish of whatever disease and illness its passengers bring aboard. (See recent cases of SARS, influenza, and tuberculosis.)

To help airlines and public health officials prepare for and avoid disease outbreaks, the Federal Aviation Administration and Purdue University researchers are developing a system to identify a disease-producing agent in an air cabin quickly and pinpoint its source. "The biggest challenge is from Mother Nature," says Yan Chen, the principal director of Purdue's Center of Excellence for Airliner Cabin Environment Research. "What we're trying to do is get the sugar and milk out of well-mixed coffee."

Chen's metaphorical coffee is the complex airflow patterns inside a cabin. Despite the complexity of the environment, it is also extremely stable, says Chen, and its stability was the key to developing the computer model that allows researchers to trace back a disease to within a cabin seat or two of its source. (The model would also work to track the source of a deliberate release of a chemical or biological agent.)

As of now, the model requires several hours, or even days, to generate a result, but Chen hopes to soon have it working in real time. "Then everyone could be protected, even in a well-mixed ventilation system," says Chen. **JONAS SIEGEL**

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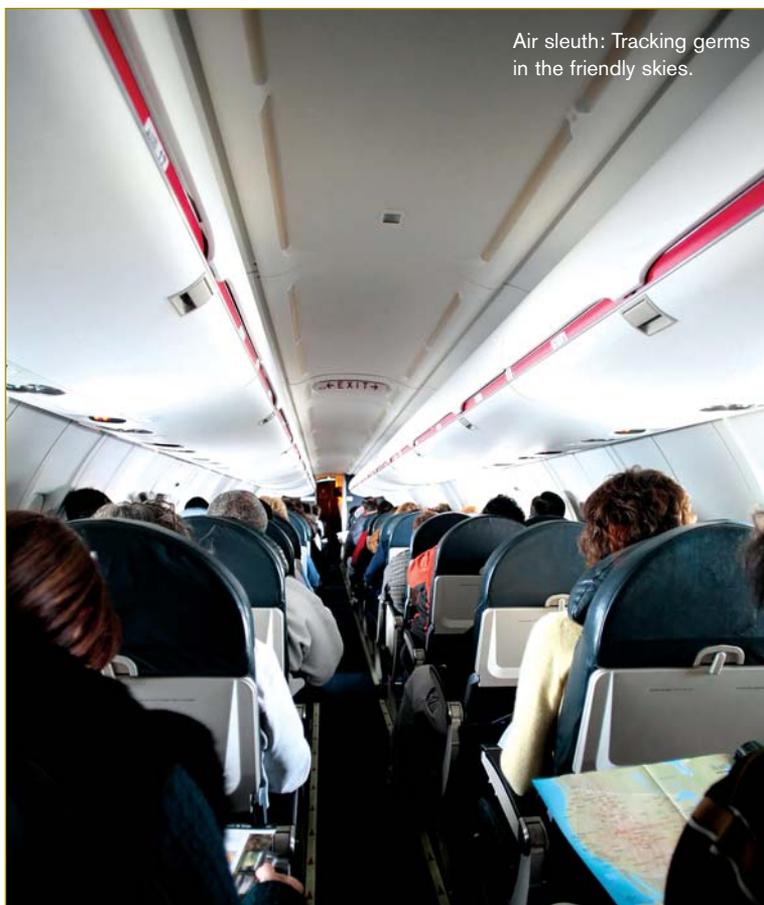
Air sleuth: Tracking germs in the friendly skies.

In the lab

The cabin. Compared to a typical room, with limited ventilation and few occupants, there are "major differences" in cabin airflow, according to Chen. Air is cycled into a cabin through many nozzles in cabin ceilings and then vented and filtered through the floor. Heat generated by dense rows of passengers, lighting, and abundant wiring and equipment, help create an active, well-mixed airflow. The continual supply of air into a cabin ensures that any interruption of the flow, for example from people walking around, will be relatively small.

The experiment. To test the results of their model, the researchers released a nontoxic agent into truncated mock-ups of a Boeing 767 cabin. Box-like devices reproduced passenger's body heat and exhalation patterns, and air circulated through a "linear diffuser" system typical to airplanes, closely replicating the cabin environment. "For research purposes we put a lot of sensors in the cabin," says Chen.

The results. After several misses, the experiments validated the model and found that only four sensors, spread along the center of a 767-cabin ceiling, are needed to trace back the source of a contaminant for the entire plane. Despite the ability to precisely reconstruct a release, no cabin area is inherently safer than any other. "It depends on where the source is," Chen says. "If the source is released in first class, then of course first class will be the first area contaminated."

ACCOMODATIONS GROUP

CORE BOMBING GROUP

KOMPAK GROUP

AN-NUR GROUP
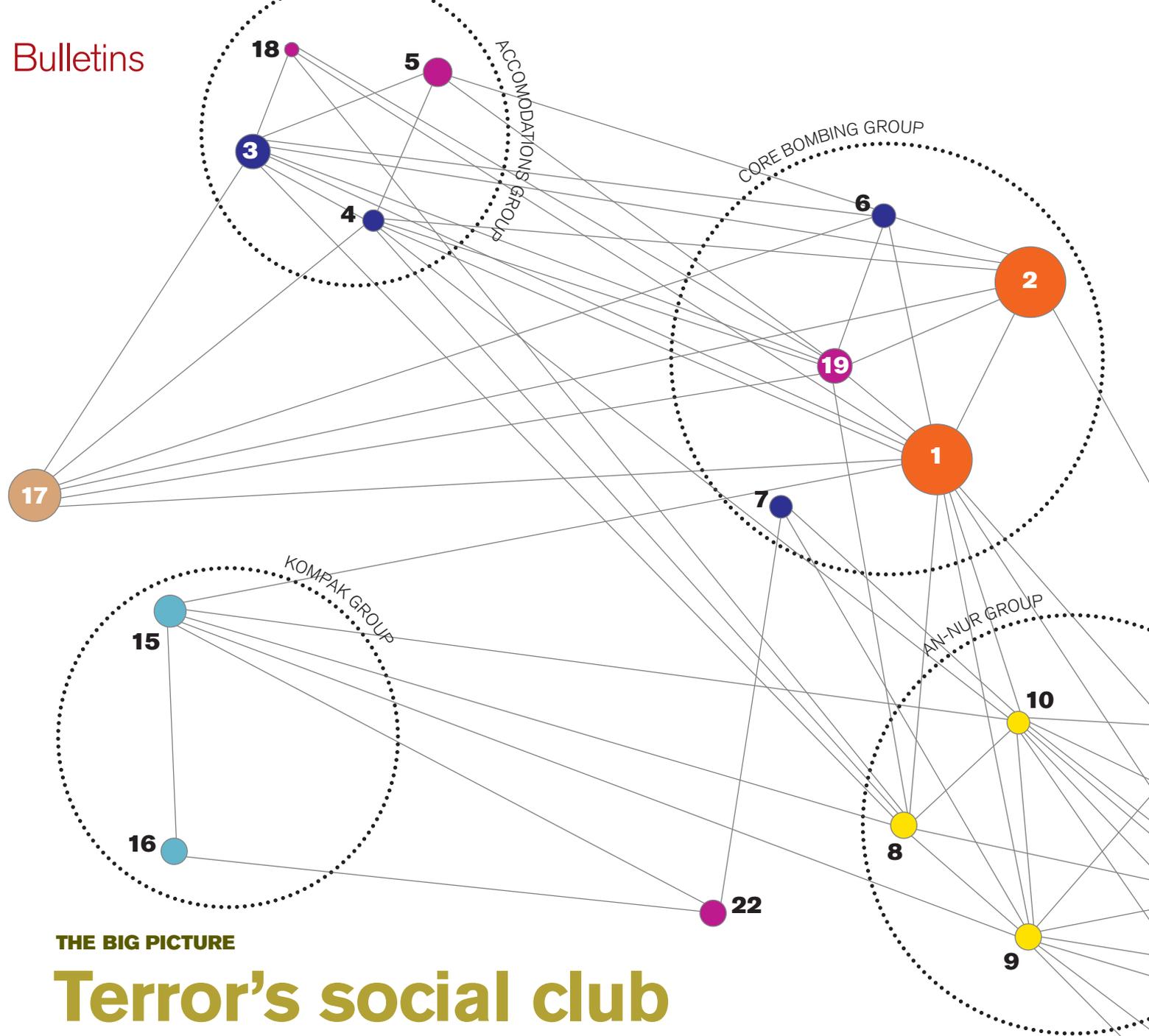
THE BIG PICTURE

Terror's social club

BY SCOTT ATRAN, MARC SAGEMAN, & JUSTIN MAGOUIRK

AT APPROXIMATELY 10:30 AM ON SEPTEMBER 9, 2004, a car bomb detonated outside the front gates of the Australian Embassy in Jakarta, Indonesia, killing 11 people and wounding hundreds. The massive explosion created a 3-meter (10-foot) deep crater, mangled the embassy's gates, and shattered windows on nearby buildings. Behind the event, clusters of social networks performed a range of functions to recruit, train, and hide militant Islamists; obtain explosives; and, ultimately, carry out the attack. These networks were all linked to Jemaah Islamiyah (JI), a terrorist organization that had begun to operate in Southeast Asia earlier in the decade.

This case demonstrates the merit of focusing on social networks and small group dynamics in terrorism analysis.

Unlike law enforcement and intelligence analyses, which stem almost entirely from incident-based catalogues of terrorist names and events, this approach builds a people-based understanding of terrorism. A close investigation of the relationships that supported and carried out the Australian Embassy bombing—and others like it—could help researchers better detail the structure and evolution of terrorist networks.

Scott Atran is a research scientist at the National Center for Scientific Research in Paris, the University of Michigan, and the John Jay College of Criminal Justice in New York City. Marc Sageman is a political sociologist and a forensic psychiatrist who worked as a CIA case officer. Justin Magouirk is executive director of the Global Transnational Terrorism project. This analysis is informed by the work of Sidney Jones at the International Crisis Group.

Accomodations

The 2004 Australian Embassy bombing was the first JI bombing led entirely by Noordin Top (**1**), a 35-year-old Malaysian explosives expert, without funding or direction from Hambali, the so-called CEO of JI. After the 2003 bombing of the Jakarta Marriott that killed 12 people and the subsequent arrest of Hambali, Top and Azhari Husin (**2**), a Malaysian academic and bomb-maker, became the most wanted men in Southeast Asia. A wide range of JI members hid them, including Adung (**3**), head of Mantiqi I (an operational division based in Malaysia), a member of the JI central command, and a key link in reconstituting JI network ties after a series of arrests in 2002 and 2003. Son Hadi (**4**), a 34-year-old preacher who worked at the Darussalam Foundation in Indonesia, as well as a mid-level JI leader (**5**), Hadi's boss at the Darussalam Foundation, also hid Top and Azhari.

Recruitment

This bombing network resulted from several key introductions across different social groups. The mid-level JI leader (**5**) introduced Heri Sigu Samboja (**6**), a 22-year-old religious teacher, to Azhari (**2**) early in 2004, and Azhari took him as his student. Gempur Budi Angkoro (**7**), alias Jabir, a 26-year-old religious teacher, also became Azhari's student in mid-June 2004. An unnamed instructor (**8**) at the radical, madrassah-style university an-Nur, introduced three of his 25-year-old students—Ubeid (**9**), Deni (**10**), and Urwah (**11**)—to Top (**1**), and all of them joined Top's radical clique of Islamist militants. Ubeid became the group's principal translator of Arabic materials. One of his tasks was to find Islamic edicts supporting violent actions, in the face of opposition from other JI members who opposed suicide bombings. Militant Islamist websites now perform similar functions.

Boot camp

Urwah (**11**), one of the three an-Nur students, later introduced Top (**1**) to Rois (**12**), a 29-year-old contact he had met at an-Nur when Rois came to the school to register his brother. Top recruited Rois to the network, and Rois immediately set up a training camp in West Java to train the bombers that would take part in the embassy operation, notably Apuy (**13**) and the suicide bomber Heri Golun (**14**), who drove the truck to the embassy and detonated the device.
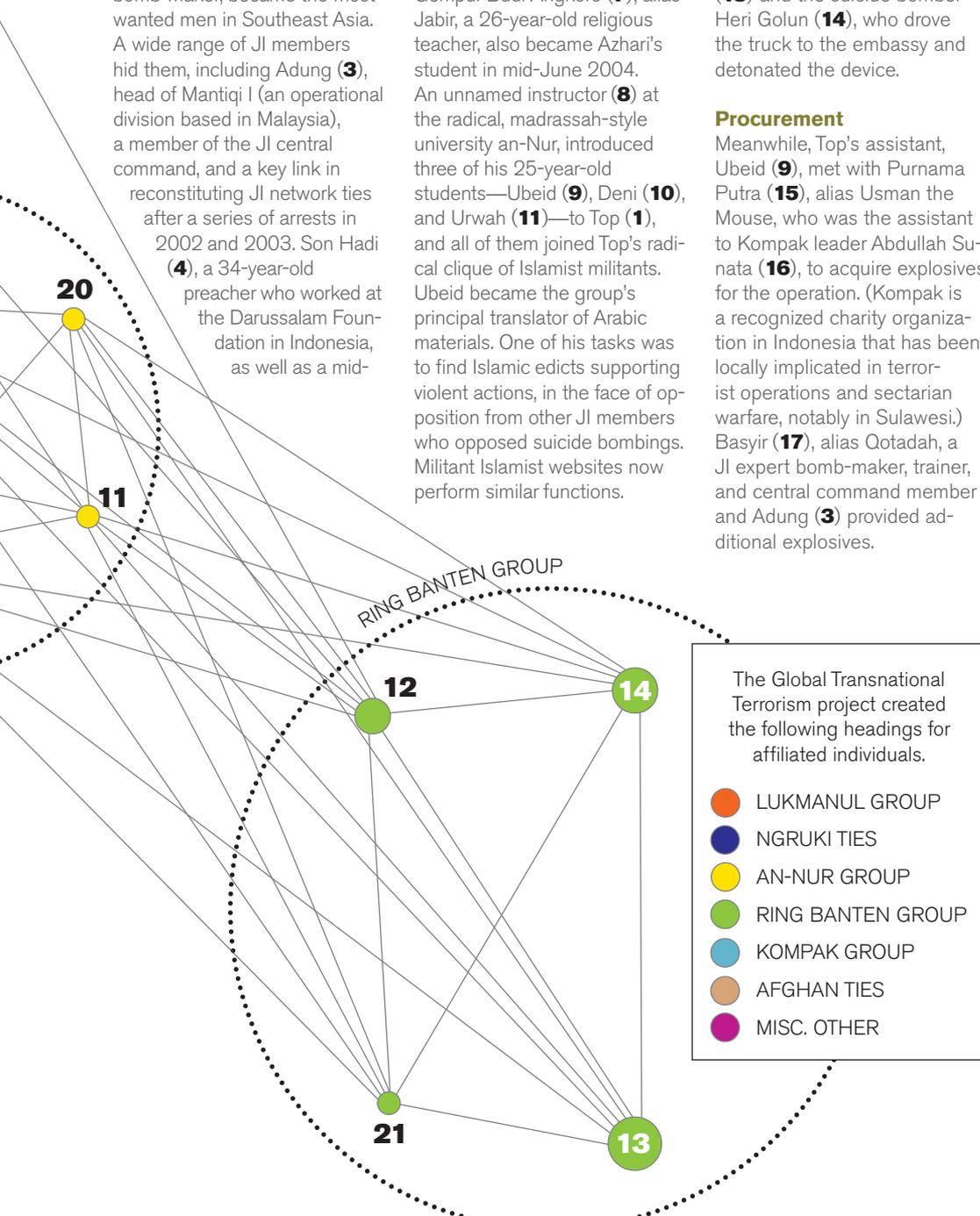
Procurement

Meanwhile, Top's assistant, Ubeid (**9**), met with Purnama Putra (**15**), alias Usman the Mouse, who was the assistant to Kompak leader Abdullah Sunata (**16**), to acquire explosives for the operation. (Kompak is a recognized charity organization in Indonesia that has been locally implicated in terrorist operations and sectarian warfare, notably in Sulawesi.) Basyir (**17**), alias Qotadah, a JI expert bomb-maker, trainer, and central command member and Adung (**3**) provided additional explosives.

Family ties

During this period of acquisitions and recruitment, Top (**1**) had time to take a second wife, Munfiatun (**18**). Top met Munfiatun, a 25-year-old Arabic teacher, through fellow bomb-maker Achmad Hasan (**19**), a marketing employee who knew her from his university days. Adung (**3**) performed the ceremony, which was witnessed by Hasan and the an-Nur instructor (**8**). This wedding further cemented ties between this group of individuals. Other familial connections in the embassy bombing network include Ubeid (**9**) and his brother (**20**); Rois (**12**) and an in-law (**21**), both of whom trained militants for the embassy operation; and Ahmad Rofiq Ridho (**22**), alias Ali Zein, who would later replace Ubeid as Top's assistant, and his cousin Jabir (**7**). Ali Zein and Jabir were also related to the infamous JI bomb-maker al-Ghozi.

Resilience

Arrests disrupted the planning of the embassy operation before it was implemented, just as they had disrupted the Marriott bombing. Officials arrested Adung (**3**), the mid-level JI leader (**5**), and Son Hadi (**4**)—all of whom had provided accommodations for Top (**1**) and Azhari (**2**)—between June and August 2004. They also arrested the an-Nur group (**8**, **9**, **10**, and **11**), which had connected Top with Rois (**12**). JI's ability to carry out the attack despite these arrests attests to the resilience of its family and school-based network. The final bombing team included Top, the director of operations; Azhari, the chief bomb-maker and second in command; Rois, the field commander; and Heri Golun (**14**), Jabir (**7**), Heri Sigu Samboja (**6**), Apuy (**13**), and Achmad Hasan (**19**) as team members.

RING BANTEN GROUP

20

11

12

14

21

13

The Global Transnational Terrorism project created the following headings for affiliated individuals.

- ⬤ LUKMANUL GROUP
- ⬤ NGRUKI TIES
- ⬤ AN-NUR GROUP
- ⬤ RING BANTEN GROUP
- ⬤ KOMPAK GROUP
- ⬤ AFGHAN TIES
- ⬤ MISC. OTHER

The presence of a tropical forest and the likelihood of a civil war appear to be related—irrespective of continent. The evidence, according to scientists at **KYOTO UNIVERSITY** in Japan: Three-quarters

RESEARCH BRIEFS

of Asian forests, two-thirds of African forests, and one-third of Latin American forests have been affected by civil wars. . . . Goodbye switchgrass, hello Miscanthus? Biologists at the **UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN** have field-tested the two perennial grasses and found that Miscanthus is twice as productive a biofuel crop as switchgrass. . . . Spanner in the works. The fast reactor design favored by the Energy Department's Global Nuclear Energy Partnership uses a liquid sodium coolant, which ignites on contact with oxygen and needs careful monitoring. Techniques using ultrasonic measurement methods developed by engineers at **KANSAS STATE UNIVERSITY** may be able to solve this problem, however, allowing safer operation of such reactors. . . . Fighting bacteria with viruses: Synthetic biologists from **MIT** and **BOSTON UNIVERSITY** have engineered an E. coli-specific phage to degrade harmful bacteria—and their protective slime—on food processing machinery, medical devices, and other surfaces. In tests, the phage destroyed 99.99 percent of the bacterial biofilm on plastic pegs.

[ON TOPIC] **NUCLEAR SMUGGLING**

Hard to track

OFFICIALLY, THE INTERNATIONAL Atomic Energy Agency (IAEA) counted 149 worldwide incidents of illicit trafficking and other unauthorized activities involving fissile materials in 2006. As it does every year, it added each to its Illicit Trafficking Database, which details more than 1,000 confirmed incidents since 1993, including thefts, losses, recoveries, illegal disposals, or attempted sales of nuclear or radioactive material.

But it's what remains unreported that concerns experts. "Almost all of the cases in the IAEA database are what I would call 'comically disorganized crime,'" says Matthew Bunn, an expert on nuclear theft at Harvard University's Belfer Center for Science and International Affairs. "Is that because that's all that's going on, or because the professionals don't get caught? We don't have the answer for that."

The IAEA recognizes that its database does not fully account for all illicit activity on the nuclear black market. But the database offers legitimate, international recognition of the events member states declare to the IAEA and confirms events reported in the media. Richard Hoskins, the head of the information management and coordination section of the IAEA's Office of Nuclear Security, and his staff scan online news services for such reports. "I would like to link more closely the analytical exploitation to identifying nuclear security needs," he says. "But we lack resources and need improvement in the types of information we possess."

The Monterey Institute of International Studies and a husband and wife team at the University of Salzburg maintain similar databases; Interpol shares restricted information with the Salzburg couple. But like the IAEA, each lacks resources. And with only a few individuals overseeing each database, it's impossible to conduct the investigations necessary to best understand nuclear smuggling's intermittent nature and the many one-time players who engage in it.   KIRSTEN JERCH

2,972 KILOGRAMS

Amount of highly enriched uranium stolen from a Russian nuclear facility in March 1994—the most of any confirmed incident in the IAEA database.

Q+A Chan-Mo Park

Is information technology (IT) bringing the world closer together? If applied properly, IT can bring the world closer together through multimedia and the internet. More than 50 company executives are participating as commissioners in the Global Information Infrastructure Commission [a confederation of business executives whose firms develop, manufacture, and deploy information and communications technologies] and that has had an impact on improving relationships between countries. The relationship between North and South Korea was cut off in 1948, but the North and the South are both thinking about how IT can bring them closer in terms of science, technology, and economics.

You are an expert on North Korea. From your visits there, assess the state of their scientific pursuits and accomplishments. North Korea is very strong in mathematics; basic sciences such as physics, chemistry; and some bioscience. They are particularly strong in software technology, even using high-level artificial intelligence techniques in their products, such as Computer Go Game, because their hardware is relatively poor. So to compensate for the hardware deficiencies, they've made an effort to make their software especially efficient. However, they are weak in hardware technology and in the commercialization of their research products because of their weakness in packaging and marketing technologies.

Is the North Korean scientific community making strides in emerging technologies?

> *"Young scientists are very smart and much more liberal than the older generation. When they become the leaders of their country, North Korea will be more open to the Western world."*

In biotechnology, they made a very rapid cloning of a rabbit several years ago. Now they are putting more emphasis on agriculture and food production, and pharmaceutical technology.

If the internet were freely available, what would it affect most profoundly: science and technology, economics, or the culture in general? Well, altering the culture is what the North Korean government is most afraid of. If the internet were made available, it would be limited by firewalls and so on, so that the government could control the flow of information. But the free exchange could improve the economy through scientific collaboration. By the way, foreigners can now use the internet in North Korea. Matter of fact, I'm corresponding with a foreigner from Switzerland in Pyonyang, but I cannot use my university e-mail address, because it has a KR designation, which means South Korea. So we are using Yahoo.com.

So, there is the capacity for internet access, but the government is afraid that by opening up the internet, there would be too much of an influx of Western influence. I think that is a mistake. About 15 years ago, China opened it up to the people, and the government is still as sound as it was before. North Korea should learn from China that the internet is not too dangerous.

If a country's vitality is dependent upon its youth, what positive signs do you see among the young scientists of North Korea, and what do you think they will be able to accomplish? I found that young scientists are very smart and much more liberal than the older generation. They know about Western culture because they have been to China many times, and they are very eager to learn about the market economy. When they become the leaders of their country, North Korea will be more open to the Western world.

If the frustration level is high among young scientists because of the

President of Pohang University of Science and Technology in South Korea, Chan-Mo Park has been vigorously involved in information technology development, including a joint project on virtual reality with North Korea's Pyongyang Informatics Center.

restrictions their government puts on them, where would they prefer to go, given the chance: China or the United States? China is easier to go to, but if they have a chance, they'd like to go to the United States. The problem is that the United States is not admitting them freely. Many information scientists would like to go to the United States for training and have asked for my help. I searched, but it was almost impossible, so I tried to arrange for them to study in Canada.

What level of computer literacy should students have before they enter college? Should there be a world standard of computer competence? Students should learn more about ethical and moral issues related to computers and the internet before entering college. As far as computer competence is concerned, IFIP [International Federation of Information Processing] is trying to develop standards for the secondary schools.

Just how expensive is a computer in North Korea? It's so expensive that even a chaired professor in a prestigious university in North Korea could not afford to have one at home. JOHN REZEK

PAUL HAMLYN