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THE NATIONAL ACADEMIES **INFOCUS**
Volume 8 Number 3 infocusmagazine.org

CONTENTS

FEATURES

NATIONAL SECURITY

ENVIRONMENT & RESOURCES

HEALTH & SAFETY

ENGINEERING & TECHNOLOGY

CONTENTS

THE NATIONAL ACADEMIES

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A Fresh Start for Science and Our Continuing Mission

With a new president in the White House, we anticipate that the National Research Council, and the three academies, the NAS, NAE, and IOM, will be asked the questions of the times. We are gratified that President Barack Obama has declared that "…it is time we once again put science at the top of our agenda and work to restore America's place as the world leader in science and technology." Scientific methods will be called upon in many contexts, and I believe that this newly expanded role for science, engineering, and medicine will help break our nation out of this period of serious economic trouble.

President Obama has selected a group of outstanding scientific leaders to help him to lead. Six are members of the NAS, and two are also members of the IOM. Nobel laureate Steven Chu is now secretary of energy. John Holdren directs the White House Office of Science and Technology Policy and is the president's science adviser. Along with Holdren, Nobel laureate Harold Varmus and Eric Lander are co-chairs of the President's Council of Advisers on Science and Technology. Jane Lubchenco administers the National Oceanic and Atmospheric Administration. And Lawrence Summers directs the White House National Economic Council. These talented individuals have served on many of our study committees, and they deserve our special thanks for accepting the president's call.

Our Research Council and Institute of Medicine reports continue to have great national impact, and a number of other nations are creating structures and processes similar to ours that will enable them to rationally guide public policy. Several ongoing studies here exemplify such efforts to inform policy. Launched last year at a National Summit on America's Energy Future, we will soon release a series of objective reports on U.S. energy options and their costs. Following a request from Congress, we are also undertaking a set of parallel studies aimed at better understanding and defining America's climate choices. A summit and four study panels will examine the sweeping issues associated with global climate change and provide advice on new strategies and actions that the nation can pursue now and in the future. A deep examination of the future of biological science is also under way.

In closing, I'm delighted to note that the 2009 Public Welfare Medal of the NAS will be presented to Neal Lane in April, recognizing his numerous and profound contributions as director of the National Science Foundation, White House science adviser, and outstanding public citizen.

RALPH J. CICERONE
President, National Academy of Sciences

PREVENTING **TERRORISM,** PROTECTING **PRIVACY**

Report Examines the Pros and Cons of Data Mining

Sending an e-mail, making a credit card purchase, phoning a friend — many Americans do these things dozens of times a day without giving it much thought. Though these activities feel ephemeral, they are recorded in vast corporate databases, becoming part of each person's digital history. Many of these databases are available to federal counterterrorism agencies, who know that terrorists use many of the same communications and financial channels as law-abiding citizens. These agencies have sought to use sophisticated computer programs to "mine" this data, trying to spot patterns that may indicate terrorist activities among the millions of transactions that happen every day.

Are these and other methods being used really successful at detecting terrorists? And how might they affect the privacy of innocent citizens who are wrongly flagged as suspicious? A recent report from the National Research Council considers these questions, and offers guidance to policymakers on balancing legitimate security needs with protection for citizens' civil liberties.

Some data-mining techniques can be effective, speeding and expanding the work of investigators who already have a lead, the report says. Agents can use them to quickly find out who has communicated with or transferred money to a known terror suspect, for example. And if there is a historical basis for concluding that a certain pattern of activity is linked to terrorism, then searching for similar patterns could yield helpful investigative leads.

The problem is that little is known about which patterns are linked to terrorism. So programs that scan databases looking for any unusual patterns are apt

to turn up far too many false leads to be useful, the report concludes. It adds that no one should be arrested, searched, or have their rights denied simply because an automated data-mining program has identified them as suspicious.

Another counterterrorism technique that agencies are researching and starting to use raises even thornier privacy concerns. Behavioral surveillance methods monitor people's actions and physiological signs — heart activity or voice tone, for example — to try to determine if someone is about to commit a terrorist attack. Right now there is no consensus on whether these techniques are ready for use at all, the report says; at most they should be used to screen people for further investigation. Even then, these techniques raise serious privacy concerns, since those who are detained will inevitably be forced to explain and justify their emotional states. For instance, a man who appears nervous before boarding an airplane may be a terrorist, or he may just be afraid to fly — something he would likely be pressured to explain if he's pulled aside.

All programs that collect or mine data or that conduct behavioral surveillance should be evaluated to determine how effective they are, whether they are lawful, and how they impact Americans' privacy, the report concludes. It offers a framework to help agencies and oversight bodies conduct these evaluations, which should include both new and existing programs.

Currently there are limits on what data may be collected, but few restrictions on how already-collected information can be used, the report notes. So an agency could gain access to a corporate database, mine it for counterterrorism purposes, and then give it to another agency to find tax evaders or deadbeat dads who are behind on child support payments. Policymakers should consider new restrictions to help prevent this "mission creep," the report says.

Innocent people who are harmed by violations of privacy should have some form of redress, the report adds. At the very least, this should include an acknowledgment of the violation and some action to lower the likelihood that it would happen again. — *Sara Frueh*

Protecting Individual Privacy in the Struggle Against Terrorists: A Framework for Program Assessment. Committee on Technical and Privacy Dimensions of Information for Terrorism Prevention and Other National Goals, Division of Behavioral and Social Sciences and Education and Division on Engineering and Physical Sciences (2008, 376 pp.; ISBN 0-309-12488-3; available from the National Academies Press, tel. 1-800-624-6242; $49.00 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12452.html>).

The committee was co-chaired by **William Perry,** former U.S. secretary of defense and Michael and Barbara Berberian Professor at Stanford University; and **Charles Vest,** president of the National Academy of Engineering. The study was funded by the U.S. Department of Homeland Security and the National Science Foundation.

FUELING THE 'NUCLEAR RENAISSANCE'

Driven by a growing need for energy and the high prices of fossil fuels, more than two dozen nations around the world — from Belarus to Vietnam to Egypt — are considering nuclear energy or have announced plans to build their first nuclear power plants. While nuclear energy could provide more countries with reliable, low-carbon-emissions power, its wider use could also have a dangerous downside. Nations that build facilities to enrich uranium themselves for nuclear fuel would then have a facility that could also be used to enrich uranium for bombs. How can the international community accommodate the growth of nuclear power while discouraging the spread of nuclear weapons?

Assuring a reliable supply of nuclear fuel would give nations less incentive to build their own uranium-enrichment plants, says a new joint report from the U.S. National Academy of Sciences and the Russian Academy of Sciences. Despite an ample supply of nuclear fuel available on the international market, "newcomer" nations may fear that relying on other countries could leave them vulnerable to being cut off if political tensions flare.

The international community should continue to explore a broad menu of ways to provide assurances against political disruptions of supply, the report says. And over time, nations should work to create a global system of international centers that can handle uranium enrichment, management of spent fuel, and other parts of the fuel cycle that pose security risks. Countries will likely feel more sure of a stable fuel supply if they are part-owners of these centers, which would also let many more nations share in the profits of uranium enrichment.

The chief disadvantage of these centers is that sensitive technology and knowledge could leak and contribute to a nation's attempt to build nuclear weapons, the report cautions. The U.S. and Russia should work diligently with other countries to create specific, stringent plans to keep this from happening.

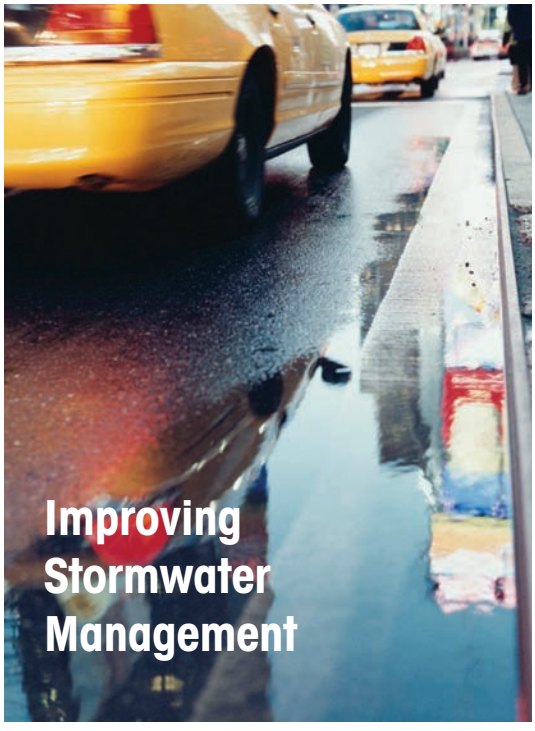
Agreeing to take back spent fuel for disposal or reprocessing could be an even stronger inducement for nations not to build their own enrichment facilities because it would let them avoid the security and environmental hazards of storing spent fuel, the report says. But it notes that taking another nation's nuclear waste is politically unpalatable for many countries. The U.S. and Russia should cooperate to lease fuel to newcomer nations for the lifetime of their reactors. For now, the spent fuel should be sent back to Russia — which is further along in offering these services — and to the U.S. as well, if it eventually becomes possible.

— *Sara Frueh*

Internationalization of the Nuclear Fuel Cycle: Goals, Strategies, and Challenges. U.S. Committee on the Internationalization of the Civilian Nuclear Fuel Cycle, U.S. National Academy of Sciences and National Research Council; and Russian Committee on the Internationalization of the Civilian Nuclear Fuel Cycle, Russian Academy of Sciences (2008, 206 pp.; ISBN 0-309-12660-6; available from the National Academies Press, tel. 1-800-624-6242; $45.75 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12477.html>).

The study was co-chaired by **John Ahearne,** executive director emeritus, Sigma Xi, Research Triangle Park, N.C.; and **Nikolay Laverov,** vice president, Russian Academy of Sciences. The study was funded by the John D. and Catherine T. MacArthur Foundation and the Carnegie Corporation of New York.

FROM SIDEWALKS TO STREAMS



Large cities are often described as concrete jungles — dense areas of manmade materials with little green space. The majority of the U.S. population now lives in cities, with the numbers expected to rise and the areas anticipated to grow. With urban expansion, however, come significant environmental impacts, especially on the nation's waterways.

After rain or snow in urban areas, large quantities of water flow over impervious surfaces — such as streets, parking lots, and rooftops — picking up various pollutants like garbage, asphalt sealants, motor fuels, and other chemicals. This polluted stormwater is then collected by natural channels and artificial drainage systems and ultimately routed to nearby streams and other bodies of water — impacting the quality of those waters.

Although urban stormwater's role in degrading water quality has been recognized for decades, reducing the role has been difficult. As a step toward improvement, in 1987 Congress brought stormwater control under the supervision of the U.S. Environmental Protection Agency, which oversees stormwater discharged by cities, industries, and construction sites. However, the current regulatory framework was originally designed to address sewage and industrial wastes, and has suffered from poor accountability and uncertainty about its effectiveness.

In light of these challenges, EPA asked the National Research Council to examine its

stormwater permitting program. The resulting report finds that radical changes are needed. EPA's current approach is not likely to produce an accurate picture of the extent of the problem, nor is it likely to control stormwater's contribution to impairing water quality. Moreover, increased water volume and pollutants from stormwater have degraded water quality and habitats in virtually every urban stream system.

"EPA's stormwater program needs a significant overhaul," said Claire Welty, chair of the committee that wrote the report and director of the Center for Urban Environmental Research and Education at University of Maryland, Baltimore County. "The changes we recommend in the report are aimed to help reverse degradation of fresh water resources and ensure progress toward the Clean Water Act's goal of 'fishable and swimmable' waters."

The committee recommended that all stormwater and other wastewater discharge permits be based on watershed boundaries instead of political boundaries in order to provide meaningful regulation. Currently, stormwater and wastewater regulations require separate permits; within stormwater regulations, different types of permits exist for municipalities, industries, and construction sites. The committee suggested that EPA adopt a watershed-based permitting system that would encompass all discharges that could impact waterways in a particular drainage basin, rather than requiring individual permits. Responsibility and authority for implementing watershed-based permits should be centralized with a lead municipality that would work in partnership with other municipalities within the watershed.

The report also says that stormwater management will be ineffective without integrating stormwater management and land management practices, as the area being appropriated for urban land use is growing faster than the population. Future land development and its potential to increase stormwater problems must be considered and addressed in EPA's program.

Additionally, it should focus less on the chemical pollutants in the stormwater and more on the increased flow of water, as the volume of discharges is generally not regulated by EPA. In urban areas, stormwater flows rapidly across surfaces and arrives at streams in short, concentrated bursts, which in turn increase streambank erosion and sediment pollution of surface water. Many urban streams are degraded as a result of this increased volume of water, but show no measurable changes on water quality.

Lastly, EPA could implement additional stormwater controls in urban areas, including conserving natural areas, reducing hard surface cover such as roads and parking lots that channel stormwater into waterways, and retrofitting urban areas with features that hold and treat stormwater. — *Jennifer Walsh*

Urban Stormwater Management in the United States. Committee on Reducing Stormwater Discharge Contributions to Water Pollution, Water Science and Technology Board, Division on Earth and Life Studies (2008, approx. 624 pp.; ISBN 0-309-12539-1; available from the National Academies Press, tel. 1-800-624-6242; $53.00 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12465.html>).

The committee was chaired by **Claire Welty,** director of the Center for Urban Environmental Research and Education and professor of civil and environmental engineering at University of Maryland, Baltimore County. The study was funded by the U.S. Environmental Protection Agency.

Public Input Makes For Better Environmental Decisions

Part of the Process

For over three decades U.S. citizens have organized themselves to help shape government decisions on environmental issues, from how EPA should clean up Superfund sites to how the U.S. Forest Service should manage the nation's woodlands. Federal legislation on such matters often requires some form of public involvement, and agencies sometimes go beyond what the law demands, actively seeking citizens' input and expertise. But enthusiasm for public participation has not been universal. Critics contend that beyond being slow and costly, public involvement actually leads to poorer decisions by including people who may not know much about the science.

Provided it's done well, public participation leads to better environmental decisions, and agencies should view it as valuable to their mission — not just a formality required by law, concludes a new report from the National Research Council. Public involvement is far more likely to improve the quality of environmental decisions than to undermine it, because citizens often have knowledge about local environmental conditions that is crucial for good scientific analysis. In addition, public values and concerns can help shape the scientific questions asked, to ensure that the science addresses problems that are relevant to people and their environment. And involving citizens gives the resulting decisions more legitimacy in the eyes of those who are affected by them — which in turn raises the chances that the decisions will be implemented effectively, the report says.

In some cases, efforts to involve the public have made matters worse, the report notes. For example, some participatory processes have been used to divert the public's energy away from criticism and into activities considered safe by an agency — a dodge that tends to be counterproductive in the long run because it ignores important conflicts.

While there's no magic method for involving the public that works in all situations, some actions can help build trust and encourage good-quality decisions across a variety of contexts. An agency should make clear at the outset how it intends to use the public's input, for example, and should commit enough staff and resources to the effort. To make sure that the science is of high quality, official analyses should be independently reviewed by outside experts who are credible to the parties involved. And the decision-making process should be flexible, allowing citizens, scientists, and officials to reconsider past conclusions as new information comes in. — *Sara Frueh*

Public Participation in Environmental Assessment and Decision Making. Panel on Public Participation in Environmental Assessment and Decision Making, Committee on the Human Dimensions of Global Change, Division of Behavioral and Social Sciences and Education (2008, 322 pp.; ISBN 0-309-12398-4; available from the National Academies Press, tel. 1-800-624-6242; $59.00 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12434.html>).

The study was chaired by **Thomas Dietz,** professor of sociology and of crop and soil sciences, and director, Environmental Science and Policy Program, Michigan State University, East Lansing. The study was funded by the U.S. Environmental Protection Agency, U.S. Department of Energy, Food and Drug Administration, and U.S. Department of Agriculture.

A Prescription to Improve Patient Safety

More **Sleep**, Better **Supervision**, and Reasonable **Workloads** for Medical Residents

When the Institute of Medicine released a report on medical residents' duty hours and workloads in early December, a flurry of debate ensued in online forums, many of the comments casting the topic as a tug of war between patients' safety and the educational needs of doctors in training. Much of the discussion focused on a single element of the report, specifically whether working as many as 80 hours a week or up to 30 hours straight is too much or too little.

But the focus on duty hours overshadowed two other key points of the report. First, the report's package of recommendations is not about shorter or longer scheduling; it's about smarter scheduling. And second, reasonable limits on duty hours by themselves are no guarantee of patient safety; other changes to residents' work environments are necessary as well to improve patient and resident safety and enhance the ability of residents to learn.

Residency is the three- to seven-year period of on-the-job training that gives recent medical school graduates the experience they need to begin practicing medicine independently. These new doctors often work long days with limited time to catch up on their sleep. A cap of 80 hours maximum per week averaged over four weeks was instituted for medical residents in 2003.

The committee of medical and scientific experts that wrote the report recognized the need to balance providing residents adequate opportunities for sleep to reduce the chances of fatigue-related errors with ensuring sufficient time for the rigorous and rich learning experiences residents need to become competent — and safe — independent care providers.

Rather than recommending an overall reduction of work hours from the 80-hour cap, the report focused on extended shifts and the need to ensure residents get regular opportunities to sleep. An extensive body of science shows that people's performance begins flagging after 16 hours of wakefulness. The report recommends that residents could work either a maximum shift of 16 continuous hours or up to 30 hours provided they get an uninterrupted five-hour break for sleep after 16 hours.

Spotty supervision also can decrease the chances of intercepting errors that could harm patients. Closer supervision leads to fewer errors, lower patient mortality, and improved quality of care. First-year residents, in particular, should not be on duty without immediate access to a supervisor on the premises.

In addition, the report calls for limits on the number of patients that residents are allowed to handle at a time based on their level of experience and specialty. Each medical specialty needs to set specific guidelines for its residents' patient caseloads. And it urges hospitals to overlap staff schedules during shift changes and to strengthen procedures for the handover of patients from one doctor's care to the next, because there will be more handovers with the schedule changes proposed by the report.

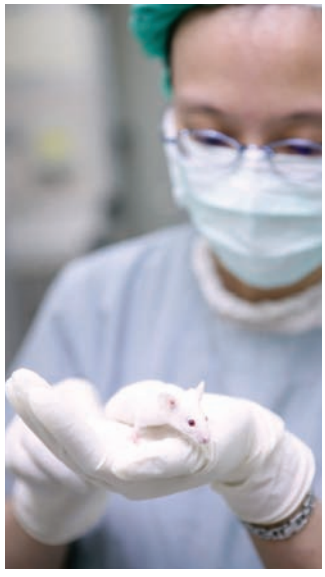
Implementing the report's recommendations inherently will require many teaching hospitals to shift work from residents to other health professionals. The committee estimated the cost for additional personnel to handle reduced resident work at roughly $1.7 billion annually. This is not an insignificant sum. However, it is less than half of 1 percent of what Medicare spends on care for older Americans annually.

Although carrying out these recommendations may be costly and logistically challenging for health care facilities, the committee believes the effort will create safer conditions for residents and patients, a higher quality of care for patients, and improved education during residency. — *Christine Stencel*

Resident Duty Hours: Enhancing Sleep, Supervision, and Safety. Committee on Optimizing Graduate Medical Trainee (Resident) Hours and Work Schedules to Improve Patient Safety, Board on Health Care Services, Institute of Medicine (2008, approx. 480 pp.; ISBN 0-309-12776-9; available from the National Academies Press, tel. 1-800-624-6242; $48.95 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12508.html>).

The committee was chaired by **Michael M.E. Johns,** chancellor, Emory University, Atlanta. The study was funded by the Agency for Healthcare Research and Quality.

PHTHALATES



A Window to Better Risk Assessment at EPA

A group of chemicals known as phthalates has been raising health concerns over the last several years. Found in a variety of consumer products, some phthalates have already been restricted from cosmetics in the European Union, as well as from children's toys in the United States and European Union.

Although few human studies have been conducted to investigate whether phthalates pose a threat to health, animal studies — particularly with rats — show that phthalates disrupt male reproductive development, leading to outcomes such as infertility and reproductive tract malformations. The lab research has also shown that the age of the animals at the time of exposure is critical to the severity of the effects; animals exposed *in utero* suffered the most complications.

Given that humans encounter multiple exposures to phthalates and that exposure to different phthalates leads to similar outcomes in lab animals, the U.S. Environmental Protection Agency should pursue a cumulative risk assessment, says a new report from the National Research Council. Furthermore, the assessment should not only include phthalates but also other chemicals that could produce similar effects on male reproductive development.

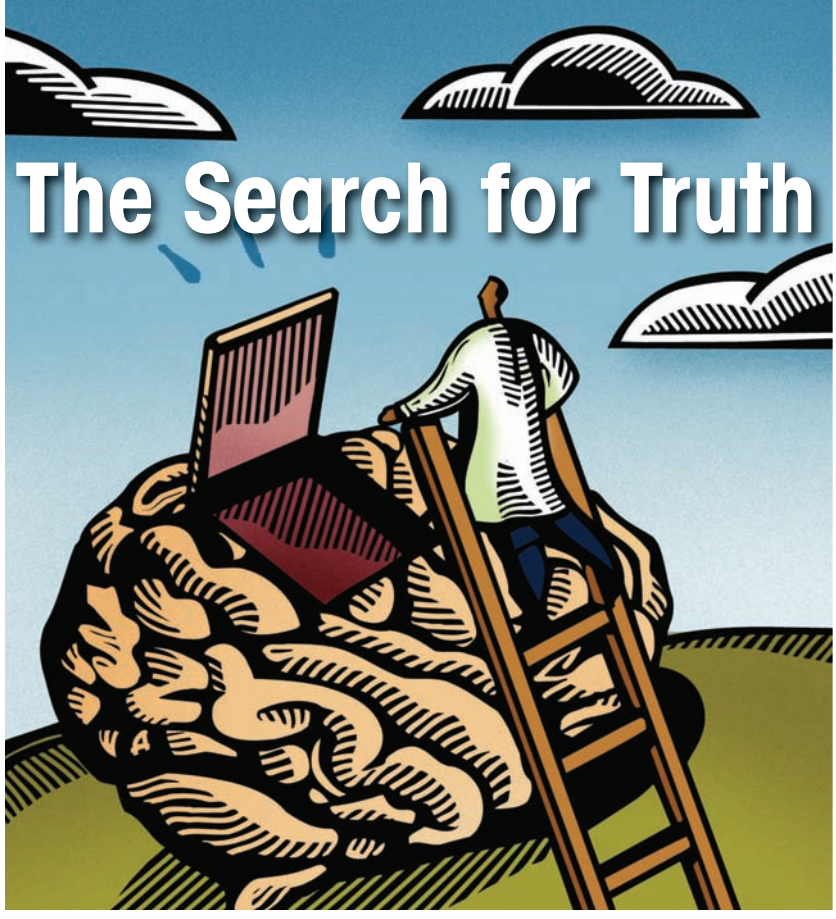
"If a cumulative risk assessment focuses solely on phthalates and excludes other chemicals, it would be artificial and could seriously underestimate risk," said Deborah Cory-Slechta, chair of the committee that wrote the report. "We need to examine how all these chemicals work together collectively and not individually."

Currently when conducting cumulative risk assessments, EPA often considers only chemicals that are similar in makeup, on the assumption that they have the same chain of reactions that lead to a final health outcome. However, that practice ignores how exposures to different chemicals may result in the same health effect. The committee called on EPA to change its strategy and apply the recommended approach for phthalates to any cumulative risk assessment. For instance, when looking at what could lead to cognitive deficits consistent with IQ reduction in children, EPA could evaluate the risk of combined exposures to lead, methylmercury, and polychlorinated biphenyls and not just examine each chemical individually.

The committee emphasized that it may be challenging for EPA to evaluate the multiplicity of human exposures resulting in common health outcomes, but it is feasible. Such a shift in approach would entail substantial efforts by EPA to define and set priorities among the most prominent adverse health effects of toxins, but it directly reflects EPA's mission to protect human health. — *Jennifer Walsh*

Phthalates and Cumulative Risk Assessment: The Tasks Ahead. Committee on the Health Risks of Phthalates, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2008, 208 pp.; ISBN 0-309-12841-2; available from the National Academies Press, tel. 1-800-624-6242; $46.00 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12528.html>).

The committee was chaired by **Deborah Cory-Slechta,** professor, department of environmental medicine, University of Rochester School of Medicine and Dentistry, Rochester, N.Y. The study was funded by the U.S. Environmental Protection Agency.



Can **Brain Imaging** Be the Perfect Lie Detector?

In June 2008, a judge in India accepted a brain scan as evidence in a murder trial. The scan was not performed on the victim to show or prove injury; instead, the scan was of the defendant, a woman accused of killing her fiancé. Although the woman denied involvement in the murder, according to the prosecution her brain activity during interrogation indicated a level of knowledge about the crime that only the killer could possess, and she was sentenced to life in prison.

These types of tests have not yet made their way into U.S. courts, but the idea of using brain scans in lie detection is becoming increasingly common. Private companies, like No Lie MRI in California, offer functional Magnetic Resonance Imaging (fMRI) tests for corporations screening new employees, lawyers hoping to validate statements made in court, and individuals looking to reduce their risk in dating. But according to a recent report from the National Research Council, the rush to use brain scans in lie detection, particularly in legal cases with significant consequences, could be premature.

The report identified current and emerging fields of cognitive neuroscience research with practical applications, including the use of neuropharmacology in regulating cognition, prostheses in enhancing performance,

and computer modeling of the human brain. Neuroimaging, a technology regularly used by doctors to scan the brain and monitor function in real-time, was discussed in the report primarily in terms of its non-health-related applications, such as determining what an individual is thinking or intending. Although brain scans have been a boon to physicians in detecting and treating neural abnormalities, their utility in measuring psychological states is still a matter of debate.

According to the committee that wrote the report, brain scans can only measure correlates of mental states like anger, fear, or deception. They can not identify the mental state itself. The fMRI measures blood flow for instance, which is an indicator of increased neural activity. Based upon the parts of the brain that show increased activity, researchers assume the mental state of the individual.

But brain scans encounter the same problem as polygraphs: no physiological indicator, or neural activity pattern, exists that has a one-to-one correspondence with mental state. A true lie detector requires an indicator that appears every time a person is being deceptive, and which appears only during deception. Researchers find that although there is some consistency in neural activity during deception, the same neurons fire during other mental and emotional states as well.

Furthermore, research on the use of brain scans in lie detection has mainly been done in the controlled environment of the lab, and researchers don't know how these findings relate to the complex and emotional lies that people tell in real life. For example, a spouse who was tempted to cheat but never acted could have enough guilt over the temptation that their brain activity patterns would be the same as someone who had cheated.

Despite the technical hurdles, some experts feel that tests such as fMRI and functional near-infrared spectroscopy hold promise in the field of lie detection. "The committee was split," said Kit Green, chair of the committee. "Those focusing on the physiological aspects [of lie detection] tend to believe that lie detectors will eventually work. Those focusing on the psychological factors were less likely to believe this."

Because truth can be subjective, influenced by experiences like religion and culture, the most fMRI could reliably show is that someone believes what they are saying is true or false. How that belief relates to the facts of a court case, or the suspicions of a spouse, is harder to determine. "If we can't yet define a lie," explained Green, "then we can't define a lie detector."

— *Rebecca Alvania*

Emerging Cognitive Neuroscience and Related Technologies. Committee on Military and Intelligence Methodology for Emergent Neurophysiological and Cognitive/Neural Science Research in the Next Two Decades, Division on Engineering and Physical Sciences and Division of Behavioral and Social Sciences and Education (2008, 214 pp.; ISBN 0-309-11894-8; available from the National Academies Press, tel. 1-800-624-6242; $49.00 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12177.html>).

The committee was chaired by **Christopher (Kit) Green,** assistant dean for Asia Pacific of the Wayne State School of Medicine in Beijing. The study was funded by the U.S. Defense Intelligence Agency.

Into Deep Space or In Too Deep?

NASA's Plans for Scientific Exploration Come at a Price

Exploration of deep space, including NASA's proposed return to the moon and visits to Mars, could provide clues to a host of scientific questions, from the origins of Earth to the history of life in our solar system. NASA is in the midst of developing the Constellation System — a system of spacecraft and launch vehicles to take humans beyond low-Earth orbit — and is considering which scientific missions would be best suited to Constellation.

A recent report from the National Research Council reviews potential science missions, evaluating the possibility of scientific advances and whether inclusion in Constellation, as opposed to using current spacecraft, would enhance the mission. The report recommends the 8-meter monolithic space telescope, Solar Probe 2, Interstellar Probe, solar polar imager, and Neptune Orbiter with probes for further study for the Constellation System. Several other missions were considered promising, but they would require greater effort to develop. The report stresses that any decisions in favor of such large space science missions need to be properly reviewed and recommended by the relevant space science decadal surveys.

For many of the proposed missions, costs could be an insurmountable hurdle. Preliminary estimates of several are over $5 billion, and the committee that wrote the report expects the actual costs to end up much higher. The report points out that in the past NASA has begun ambitious space science missions that ended up too expensive to pursue, such as the Voyager-Mars mission and the Jupiter Icy Moons Orbiter mission of the Prometheus program.

According to the report, the Constellation System alone might be insufficient for many of the proposed science missions and additional technological developments may be required. NASA currently lacks a technology development strategy for science missions, however.

NASA could reduce costs for Constellation space science by embarking on joint science missions with other countries, thereby taking advantage of international scientific and technological expertise and saving money using foreign instruments and infrastructure. Ultimately, however, the Constellation System is being developed to further human exploration of space, not to perform science missions, the report points out. Constellation offers many opportunities for advancing knowledge, but unless NASA's funding situation changes significantly in coming years, the cost of science in deep space could be too high. — *Rebecca Alvania*

Launching Science: Science Opportunities Provided by NASA's Constellation System. Committee on Science Opportunities Enabled by NASA's Constellation System, Space Studies Board and Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences (2008, approx. 160 pp.; ISBN 0-309-11644-9; available from the National Academies Press, tel. 1-800-624-6242; $37.25 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12554.html>).

The committee was chaired by **George Paulikas,** former executive vice president of Aerospace Corp. The study was funded by NASA.

An African Parliamentarian Speaks on the Unique Value of Academies

At the fourth annual conference of the African Science Academy Development Initiative (ASADI), recently held in London, Patrick Amuriat Oboi, a member of the Parliament of Uganda and its Committee on Science and Technology, delivered the opening address. The following are excerpts of his speech "Why Would a Government Want Independent Advice?"

"The current disparity between developed and developing nations is due to the level and extent of application of scientific and technological capacities and innovation. Owing to this disparity, there is a need for governments, especially in the developing world, to engage in policies that are guided by independent advice.

"While many elements within a nation can produce credible scientific advice, a science academy can do so with a unique level of credibility due to its independence from nonscientific influences, the degree of access to leading experts and scientific literature, and the use of

rigorous consensus and external review methods. An academy that releases its advice to not only sponsors but also to the general public fosters democratic processes by providing information important to public debate.

"Evidence-based advice is helpful in clarifying, buttressing, or even challenging a particular policy position. It can also help to entrench policy decisions, both enriching the process and probably legitimizing the decisions. [Because] many major donor and international lending institutions are increasingly basing aid and loans on the condition that reforms ensuring good governance are undertaken, tools that reinforce effective decision formulation and implementation, such as evidence-based advice, will help [nations] gain access to limited development assistance resources.

"The government of Uganda is adopting this approach [of using evidence-based advice as a policy planning tool] and has been particularly vocal on the subject. It can be projected that the practice of evidence-based policymaking will gain increasing attention in the foreseeable future, both in Uganda and other developing countries.

"There are challenges, however. Scientific research that would generate evidence-based information can be costly, and it may take a very long time for its benefits to be realized. In developing countries like Uganda, where floods, food and water shortages, outbreaks of disease, the effects of HIV/AIDS, and internal conflicts occur, the funding of scientific research [will not be the first priority]. Getting governments to act is another challenge. Independent advice, however convincing, may not impact policy if the policymakers do not embrace it.

"My conclusion is that African science academies and other organizations offering independent advice have an evident role to play in advancing national socio-economic aspirations. To fully apply their potential, the academies should be effectively linked into government policy implementation frameworks.

"At the broadest level, ASADI can contribute to improving the effectiveness and efficiency of key policy decisions, which can in turn contribute to development goals, such as improved human health. It can promote the development process of Africa by strengthening the physical and intellectual infrastructure of science academies and their staff and by increasing the academies capacity to interact with their governments."

ASADI is a multiyear collaborative effort led by the U.S. National Academies and funded by the Bill & Melinda Gates Foundation, to strengthen the capacity of African science academies to inform public policy and discourse through independent, evidence-based advice. For Oboi's full presentation, visit the ASADI homepage at <national-academies.org/asadi>.

New Stem Cell Guidelines

The National Research Council and Institute of Medicine released amended guidelines for research involving human embryonic stem cells, revising those that were issued in 2005 and updated in 2007.

The guidelines were originally produced to offer a common set of ethical standards for the responsible conduct of research using human embryonic stem cells, which have the

potential to produce all the body's cell types. Scientists are currently working to harness stem cells' ability to regenerate themselves and produce specialized cells.

One reason for the modifications is to provide guidance on the derivation and use of new stem cells called "induced pluripotent cells." They are made by reprogramming nonembryonic adult cells into a stem-cell-like state and manipulating them to form an array of specialized cells. The guidelines contain provisions for work with induced pluripotent cells that are similar to those in place for embryonic cell lines. At this time it is still undetermined which types of stem cell will prove the most useful for regenerative medicine, as each will most likely have some utility. Therefore, the need for research with human embryonic stem cells still exists despite the availability of new cell sources, the guidelines say. Additionally, the amendments clarified the expenses for which female egg donors can be reimbursed should include lost wages.

The standing advisory committee that wrote the guidelines also held a symposium in November to explore the path toward using stem cells in clinical applications, including their use in the treatment of Parkinson's and heart disease. For more information, visit <national-academies.org/stemcells>. — *Jennifer Walsh*

Science Comes to Hollywood

The National Academy of Sciences launched a new initiative called the Science and Entertainment Exchange, which is designed to connect top scientists and engineers with entertainment professionals to help them develop more accurate science content in films, TV shows, and videogames.

"By building a strong connection between the entertainment and science communities, we're hoping to provide an important service to both Hollywood and the viewing public," said NAS President Ralph Cicerone.

NAS announced the initiative in Los Angeles and held a symposium to introduce Hollywood to the new program. Some 350 screenwriters, producers, and set designers were inspired and entertained by some of the most prestigious scientists in the U.S., talking about their research, including Nobel Prize winner Steve Chu, the new U.S. secretary of energy, Rodney Brooks from the Massachusetts Institute of Technology, Neil DeGrasse Tyson from the Hayden Planetarium in New York City, and Craig Venter from the Craig Venter Institute.

Film director Jerry Zucker and his wife, producer Janet Zucker, co-hosted the event. "The Exchange will provide a place where scientific and artistic minds can come together to inspire each other, building a two-way street for both communities to learn and create," Jerry said.
— *Maureen O'Leary*

Publications

For documents shown as available from the National Academies Press (NAP), write to 500 Fifth St., N.W., Lockbox 285, Washington, D.C. 20055; tel. 202-334-3313 or 1-800-624-6242; or order on the Internet at <www.nap.edu>. Documents from a specific unit of the National Academies are available from the source as noted.

The 2nd International Forum on Biosecurity: Summary of an International Meeting, Budapest, Hungary, March 30 to April 2, 2008
Development, Security, and Cooperation and Board on International Scientific Organizations, Division on Policy and Global Affairs (2008, approx. 134 pp.; ISBN 0-309-12829-3; available from NAP).

Acute Exposure Guidelines for Selected Airborne Chemicals, Vol. 7
Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2008, approx. 236 pp.; ISBN 0-309-12755-6; available from NAP).

Addressing the Barriers to Pediatric Drug Development — Workshop Summary
Board on Health Sciences Policy, Institute of Medicine (2008, 64 pp.; ISBN 0-309-10742-3; available from NAP).

Adolescent Health Services: Missing Opportunities
Board on Children, Youth, and Families, National Research Council and Institute of Medicine (2008, 368 pp.; ISBN 0-309-11467-5; available from NAP).

Assessing the Research and Development Plan for the Next Generation Air Transportation System — Summary of a Workshop
Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences (2008, 38 pp.; ISBN 0-309-12470-0; available from NAP).

Assessment of the Role of Intermittent Preventive Treatment for Malaria in Infants — Letter Report
Board on Global Health, Institute of Medicine (2008, 80 pp.; available only online from NAP).

Community Perspectives on Obesity Prevention in Children — Summary of a Workshop
Food and Nutrition Board, Institute of Medicine (2008, 30 pp.; available only online from NAP).

A Constrained Space Exploration Technology Program: A Review of NASA's Exploration Technology Development Program
Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences (2008, 154 pp.; ISBN 0-309-12583-9; available from NAP).

Construction Research at NIOSH: Reviews of Research Programs of the National Institute for Occupational Safety and Health
Board on Infrastructure and the Constructed Environment, Division on Engineering and Physical Sciences (2008, approx. 200 pp.; ISBN 0-309-12850-1; available from NAP).

Coverage Measurement in the 2010 Census
Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2008, 180 pp.; ISBN 0-309-12826-9; available from NAP).

Department of Homeland Security Bioterrorism Risk Assessment: A Call for Change
Board on Mathematical Sciences and Their Applications, Division on Engineering and Physical Sciences; and Board on Life Sciences, Division on Earth and Life Studies (2008; 172 pp.; ISBN 0-309-12028-4; available from NAP).

Design Considerations for Evaluating the Impact of PEPFAR — Workshop Summary
Board on Global Health, Institute of Medicine (2008, 142 pp.; ISBN 0-309-11672-4; available from NAP).

Disrupting Improvised Explosive Device Terror Campaigns: Basic Research Opportunities — A Workshop Report
Board on Chemical Sciences and Technology, Division on Earth and Life Studies (2008, 80 pp.; ISBN 0-309-12420-4; available from NAP).

Ecological Impacts of Climate Change
Board on Life Sciences, Division on Earth and Life Studies (2008, 70 pp.; ISBN 0-309-12710-6; available from NAP).

Ensuring the Climate Record from the NPOESS and GOES-R Spacecraft: Elements of a Strategy to Recover Measurement Capabilities Lost in Program Restructuring
Space Studies Board, Division on Engineering and Physical Sciences (2008, 190 pp.; ISBN 0-309-12184-1; available from NAP).

Evaluation of the Multifunction Phased Array Radar Planning Process
Board on Atmospheric Sciences and Climate, Division on Earth

and Life Studies (2008, 92 pp.; ISBN 0-309-12432-8; available from NAP).

Evaluation of Quantification of Margins and Uncertainties Methodology for Assessing and Certifying the Reliability of the Nuclear Stockpile
Division on Engineering and Physical Sciences (2008, approx. 100 pp.; ISBN 0-309-12853-6; available from NAP).

Evidence-Based Medicine and the Changing Nature of Healthcare — Workshop Summary
Institute of Medicine (2008, 202 pp.; ISBN 0-309-11369-5; available from NAP).

The Federal Investment in Highway Research, 2006-2009: Strengths and Weaknesses — Special Report 295
Research and Technology Coordinating Committee, Transportation Research Board (2008, 146 pp.; ISBN 0-309-12605-3; available from NAP).

Fifteenth Interim Report of the Committee on Acute Exposure Guideline Levels
Committee on Toxicology, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2008, 50 pp.; available only online from NAP).

A Framework for Assessing the Health Hazard Posed by Bioaerosols
Board on Chemical Sciences and Technology and Board on Life Sciences, Division on Earth and Life Studies (2008, 100 pp.; ISBN 0-309-11150-1; available from NAP).

From Molecules to Minds: Challenges for the 21st Century — Workshop Summary
Board on Health Sciences Policy, Institute of Medicine (2008, 90 pp.; ISBN 0-309-12092-6; available from NAP).

Global Challenges and Directions for Agricultural Biotechnology — Workshop Report
Board on Agriculture and Natural Resources and Board on Life Sciences, Division on Earth and Life Studies (2008, 74 pp.; ISBN 0-309-12077-2; available from NAP).

Global Climate Change and Extreme Weather Events: Understanding the Contributions to Infectious Disease Emergence — Workshop Summary
Board on Global Health, Institute of Medicine (2008, 304 pp.; ISBN 0-309-12402-6; available from NAP).

Great Lakes Shipping, Trade, and Aquatic Invasive Species — Special Report 291
Transportation Research Board; and Water Science and Technology Board, Division on Earth and Life Studies (2008, 148 pp.; ISBN 0-309-11313-X; available from NAP).

Gulf War and Health, Vol. 7: Long-Term Consequences of Traumatic Brain Injury
Board on Population Health and Public Health Practice, Institute of Medicine (2008, 396 pp.; ISBN 0-309-12408-53; available from NAP).

The Health Hazard Evaluation Program at NIOSH
Division on Earth and Life Studies (2008, approx. 250 pp.; ISBN 0-309-12647-9; available from NAP).

HHS in the 21st Century: Charting a New Course for a Healthier America
Institute of Medicine (2008, approx. 312 pp.; ISBN 0-309-12123-X; available from NAP).

Implementing Colorectal Cancer Screening — Workshop Summary
National Cancer Policy Forum, Institute of Medicine (2008, 115 pp.; ISBN 0-309-12139-6; available from NAP).

Information and Communication Technology and Peacebuilding — Summary of a Workshop
National Academy of Engineering (2008, 58 pp.; ISBN 0-309-12188-4; available from NAP).

Managing Health Effects of Beryllium Exposure
Committee on Toxicology, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2008, 186 pp.; ISBN 0-309-12532-4; available from NAP).

Maritime Security Partnerships
Naval Studies Board, Division on Engineering and Physical Sciences (2008, 242 pp.; ISBN 0-309-11261-3; available from NAP).

Military Medical Ethics: Issues Regarding Dual Loyalties — Workshop Summary
Board on Health Sciences Policy, Institute of Medicine (2008, 74 pp.; ISBN 0-309-12663-0; available from NAP).

New Directions in Climate Change Vulnerability, Impacts, and Adaptation Assessment — Summary of a Workshop
Committee on Human Dimensions of Global Change, Division of Behavioral and Social Sciences and

Education (2008, approx. 40 pp.; ISBN 0-309-13006-9; available from NAP).

Nutrient Control Actions for Improving Water Quality in the Mississippi River Basin and Northern Gulf of Mexico
Water Science and Technology Board, Division on Earth and Life Studies (2008, approx. 76 pp.; ISBN 0-309-13000-X; available from NAP).

Observing Weather and Climate From the Ground Up: A Nationwide Network of Networks
Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2008, 250 pp.; ISBN 0-309-12986-9; available from NAP).

The Personal Protective Technology Program at NIOSH: Reviews of Research Programs of the National Institute for Occupational Safety and Health
Board on Health Sciences Policy, Institute of Medicine (2008, 214 pp.; ISBN 0-309-12018-7; available from NAP).

Progress Toward Restoring the Everglades: The Second Biennial Review, 2008
Water Science and Technology Board and Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2008, 340 pp.; ISBN 0-309-12574-X; available from NAP).

Rebuilding the Research Capacity at HUD
Center for Economic, Governance, and International Studies, Division of Behavioral and Social Sciences and Education (2008, 236 pp.; ISBN 0-309-12567-7; available from NAP).

Review of the 21st Century Truck Partnership
Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences (2008, 130 pp.; ISBN 0-309-12208-2; available from NAP).

Review of ATSDR's Great Lakes Report Drafts — Letter Report
Board on Population Health and Public Health Practice, Institute of Medicine (2008, 50 pp.; available only online from NAP).

Review of Directed Energy Technology for Countering Rockets, Artillery, and Mortars (RAM): Abbreviated Version
Board on Army Science and Technology, Division on Engineering and Physical Sciences (2008, 42 pp.; ISBN 0-309-11171-4; available from NAP).

Review of Federal Strategy for Nanotechnology-Related Environmental, Health, and Safety Research
Committee on Toxicology, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies; and National Materials Advisory Board, Division on Engineering and Physical Sciences (2008, approx. 130 pp.; ISBN 0-309-11699-6; available from NAP).

Review of NASA's Exploration Technology Development Program — An Interim Report
Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences (2008, 74 pp.; ISBN 0-309-11943-X; available from NAP).

Review of NASA's Human Research Program Evidence Books — A Letter Report
Board on Health Sciences Policy, Institute of Medicine (2008, 100 pp.; available only online from NAP).

Review of Secondary Waste Disposal Planning for the Blue Grass and Pueblo Chemical Agent Destruction Pilot Plants
Board on Army Science and Technology, Division on Engineering and Physical Sciences (2008, 84 pp.; ISBN 0-309-12050-0; available from NAP).

Safety of Dietary Supplements for Horses, Dogs, and Cats
Board on Agriculture and Natural Resources, Division on Earth and Life Studies (2008, 216 pp.; ISBN 0-309-12570-7; available from NAP).

Satellite Observations to Benefit Science and Society: Recommended Missions for the Next Decade
Space Studies Board, Division on Engineering and Physical Sciences (2008, 40 pp.; ISBN 0-309-10903-5; available from NAP).

Science and Decisions: Advancing Risk Assessment
Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2008, approx. 478 pp.; ISBN 0-309-12046-2; available from NAP).

Science as a Gateway to Understanding: International Workshop Proceedings, Tehran, Iran
Office for Central Europe and Eurasia; Development, Security, and Cooperation; Division on Policy and Global Affairs (2008, 184 pp.; ISBN 0-309-12879-X; available from NAP).

Science and Technology for America's Progress: Ensuring the Best Presidential Appointments in the New Administration
Committee on Science, Engineering, and Public Policy; National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (2008, 76 pp.; ISBN 0-309-12680-0; available from NAP).

Science and Technology and the Future Development of Societies — International Workshop Proceedings
Office for Central Europe and Eurasia, Division on Policy and Global Affairs (2008, 142 pp.; ISBN 0-309-11927-8; available from NAP).

Science Professionals: Master's Education for a Competitive World
Board on Higher Education and Workforce, Division on Policy and Global Affairs (2008, 148 pp.; ISBN 0-309-11471-3; available from NAP).

Spacecraft Maximum Allowable Concentrations for Selected Airborne Contaminants, Vol. 5
Committee on Toxicology, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2008, 386 pp.; ISBN 0-309-12844-7; available from NAP).

Spacecraft Water Exposure Guidelines for Selected Contaminants, Vol. 3
Committee on Toxicology, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2008, 206 pp.; ISBN 0-309-12838-2; available from NAP).

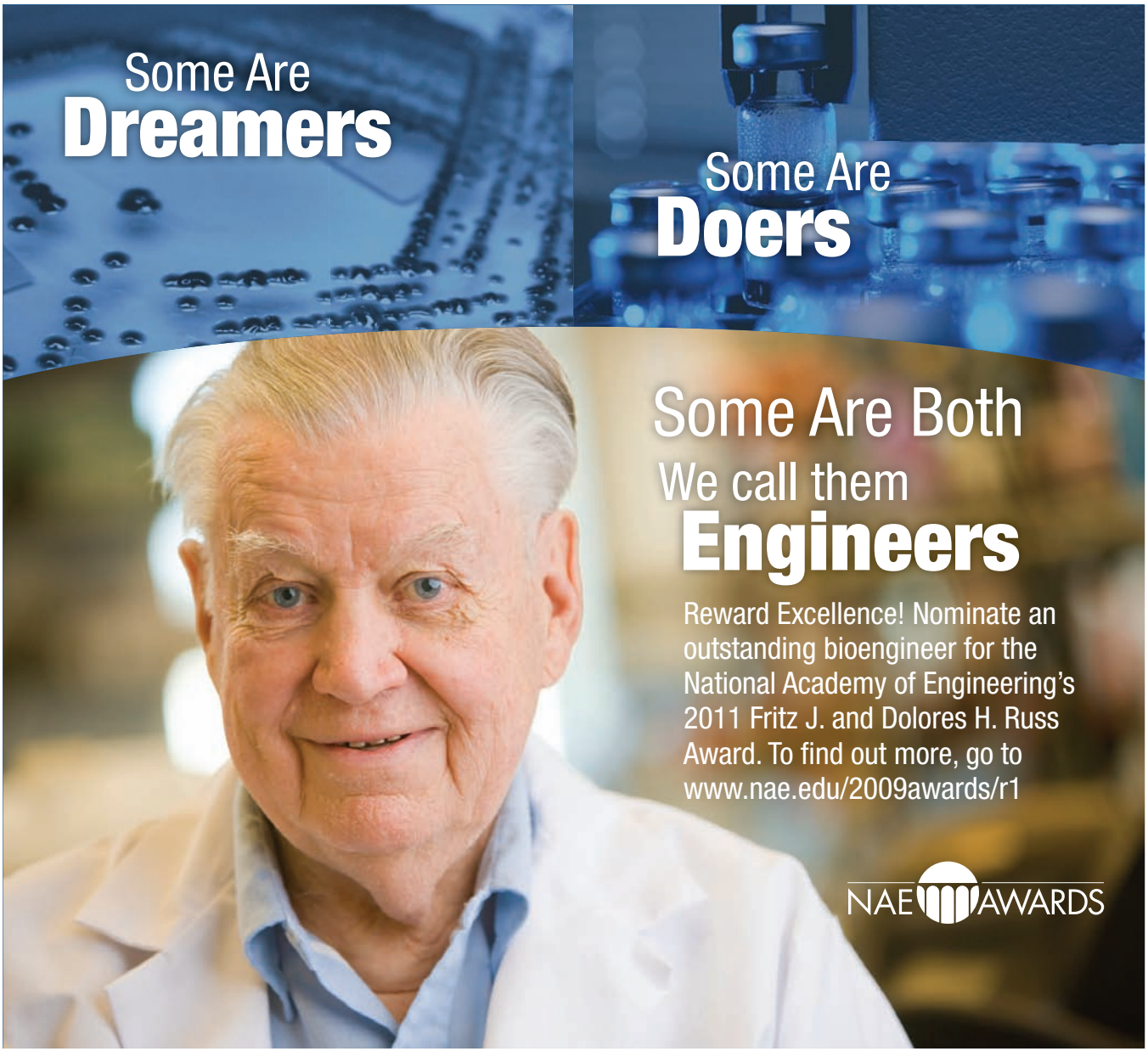
Systems Engineering to Improve Traumatic Brain Injury Care in the Military Health System — Workshop Summary
National Academy of Engineering and Institute of Medicine (2008, approx. 184 pp.; ISBN 0-309-12758-0; available from NAP).

Tackling Marine Debris in the 21st Century
Ocean Studies Board, Division on Earth and Life Studies (2008, 218 pp.; ISBN 0-309-12697-5; available from NAP).

Test and Evaluation of Biological Standoff Detection Systems — Abbreviated Version
Board on Chemical Sciences and Technology and Board on Life Sciences, Division on Earth and Life Studies (2008, 42 pp.; ISBN 0-309-11443-8; available from NAP).

Transitions to Alternative Transportation Technologies: A Focus on Hydrogen
Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences (2008, 142 pp.; ISBN 0-309-12100-0; available from NAP).

Understanding Crime Trends — Workshop Report
Committee on Law and Justice, Division of Behavioral and Social Sciences and Education (2008, 254 pp.; ISBN 0-309-12586-3; available from NAP).



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