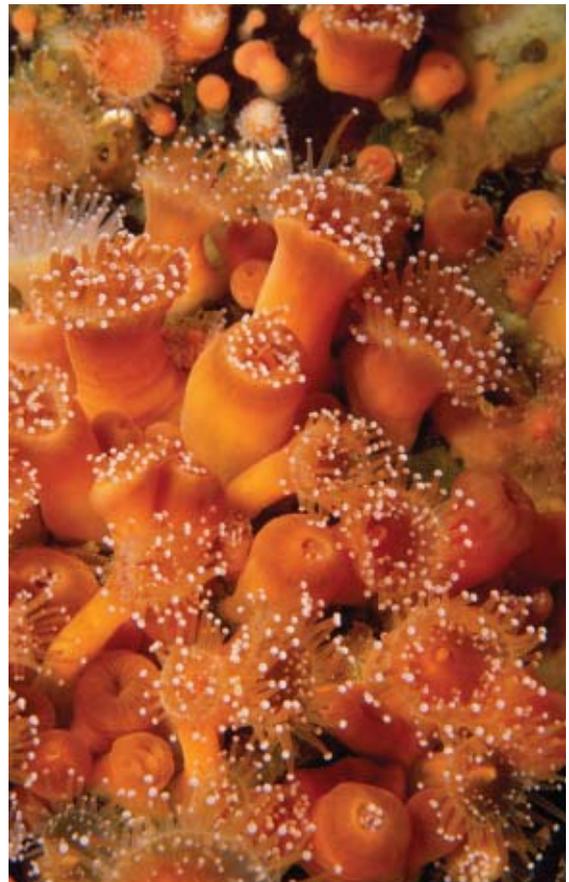


THE NATIONAL ACADEMIES **IN FOCUS**

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Keys to Recovery of Endangered Fishes
Nurses and Their Work Environment
Technologies to Boost Seat-Belt Use
A Plan for Deep Ocean Exploration

Winter/Spring 2004

THE NATIONAL ACADEMIES *Advisers to the Nation on Science, Engineering, and Medicine*

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Recognizing the Extraordinary Contributions of Engineering

Average citizens probably don't spend a lot of time thinking about how engineering has changed their lives. Yet, society's transformation in only the last 100 years because of engineering is nothing short of stunning. In 1904 the country was not electrified; the airplane had just made its first flight; Ford had just opened his assembly line making cars affordable; few people had phones; the average life span was 46 — mostly due to unclean water and poor sanitation; radio, television, computers and the Internet did not exist — and the list goes on.



In conjunction with our broader program on the Public Understanding of Engineering, the National Academy of Engineering has established a set of major prizes to acknowledge and celebrate the contributions of engineering to society. With these prizes, each now valued at \$500,000, we aim to recognize individual achievements that demonstrate the rich and profound ways in which engineering improves the quality of life for all of us.

NAE introduced its first major prize in 1989, the Charles Stark Draper Prize. Originally awarded every other year, the prize was made annual in 2001. This year's team of winners — Alan Kay, Butler Lampson, Robert Taylor, and Charles Thacker — designed and developed the first networked personal computer. Other accomplishments that have been recognized by the Draper Prize include the global positioning system, polymers for the controlled release of drugs, the Internet, fiber optics, the jet engine, and integrated circuits.

In 2001 NAE introduced the Fritz J. and Dolores H. Russ Prize. Focused on critically important newer areas of engineering, this prize is being given, at least initially, for contributions to bio-engineering. The achievements that have been recognized so far are the implantable pacemaker and the artificial kidney.

And the Bernard M. Gordon Prize was introduced in 2002 for contributions to engineering education. This year, Frank S. Barnes, won the award for pioneering a program that produces leaders who bridge engineering, social sciences, and public policy. Additional information on Barnes and all past winners of these prizes can be viewed on the Web at www.nae.edu/awards.

The contributions of engineers to society is not slowing down. Indeed, the pace of technological innovation and its impact seems to be increasing — the penetration that took the radio 60 years to achieve was accomplished in 10 by the World Wide Web. The National Academy of Engineering's prizes — like the Nobel prizes — present a moment each year when the public can pause and reflect on some of mankind's truly noteworthy achievements.

A handwritten signature in black ink that reads "Wm. A. Wulf". The signature is stylized with a large, sweeping flourish at the end.

WM. A. WULF

President, National Academy of Engineering

A New Outlook for **URBAN HIGH SCHOOLS**



Changes Can Help Improve Inner-City Education

For many teens, school is an impersonal and uncaring place. The situation is especially troubling in urban areas, where high schools are often beset by low expectations, student alienation, underachievement, and high dropout rates. Frequently, resources are inadequate and teachers poorly trained. Plus, curricula and instruction seldom reflect actual student needs and interests — particularly for those who are racial minorities, who speak English as a second language, or who have not been well-prepared for high school work.

These schools are not lost causes, however. Research on motivation and engagement provides clear guidance on the most promising strategies that nurture enthusiasm for learning among all students, says a new report from the National Research Council and the Institute of Medicine. Schools do not control all of the factors that shape students' eagerness to learn, but

they can be structured in a way that significantly influences attitudes and behavior.

Foremost, the academic program must be challenging and engaging to students from various backgrounds. Instruction should respond to wide differences in what students already know and help them acquire the skills necessary to master rigorous coursework. The report also encourages schools to abandon the practice known as ability “tracking,” in which students of similar achievement levels are taught together. Studies have shown that it often isolates low-performing or unmotivated schoolchildren and reinforces low standards and expectations.

Educating heterogeneous classrooms with demanding curricula can be done, the report says, but only if teachers are properly trained. Teacher-education programs should prepare future instructors to work effectively with academically and socially

diverse groups of students and to use teaching approaches that actively involve young people in problem solving. And school districts should provide experienced teachers with opportunities for ongoing professional development, both to expand their knowledge of adolescent behavior and to enhance their mastery of subject matter and innovative teaching methods.

In addition, counseling services should be totally revamped. In many large high schools, individual guidance counselors are overwhelmed by the responsibility of working with hundreds of students.

Instead, monitoring the needs and progress of each student should be a duty shared by all professional staff members, including teachers, administrators, and counselors — as well as qualified support staff, the report says.

Likewise, students need caring and stable relationships with adult faculty and staff members to clear academic hurdles. All young people benefit from such bonds, the report emphasizes. One way to encourage a close, personal atmosphere is to create small “learning communities” or mini-schools within large urban high schools, which often enroll more than 2,000 pupils.

When it comes to assessment, standardized tests commonly used to evaluate students should be better aligned with academic standards that promote thorough understanding and critical thinking, the report says. Currently, standardized-test results rarely offer teachers the feedback they need to improve instruction or learn-



ing. Also, educators should use various classroom assessments to routinely track the effectiveness of specific curricula and teaching practices.

Education extends beyond the schoolhouse, as well, the report points out, and community assets are important for urban high schools. School administrators should establish or strengthen partnerships with local groups and social-service providers to help students address health problems and other personal issues that interfere with their education. And the broader community should be regularly mined for experiences and resources

that can enrich classroom instruction, such as community internships and direct interactions with local leaders and artists.

The ways to bring about progress in urban high schools have grown increasingly clear, the report says. The will to use this knowledge, integrating research findings into everyday school practices and education policy, is sorely needed — as is a realignment of resources to support school improvement. — *Vanee Vines*

■ **Engaging Schools: Fostering High School Students' Motivation to Learn.** Committee for Increasing High School Students' Engagement and Motivation to Learn, Board on Children, Youth, and Families, National Research Council and Institute of Medicine (2003, 304 pp.; ISBN 0-309-08435-0, available from the National Academies Press, tel. 1-800-624-6242; \$44.95 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10421.html>).

The committee was chaired by **Deborah Stipek**, dean, School of Education, Stanford University, Stanford, Calif. The study was sponsored by the Carnegie Corporation of New York.



VIOLENCE and Women

A Focused Research Effort Needed

Violence against women is one of the nation's most intractable social problems. It touches people from all walks of life. Its effects show up in emergency rooms, courtrooms, and the workplace. Each year in the United States, more than 4 million women are assaulted, often by people they know, and 300,000 rapes are reported. Women also account for one-fifth of all homicide victims. Yet little is known about the prevalence of such crimes or which public policies would prevent them effectively.

More research is needed to bridge persistent gaps in the science base, says a new report from the National Research Council. For starters, research on violence against women — and even by them — would be enriched if it were better integrated with other scientific studies of violent crime in general. Focusing on women's victimization as well as on their own acts of aggression has allowed scholars to tease out unique aspects of the problem and to carefully examine how policy-makers have responded. But a stronger connection to research on all violence would provide a more solid scientific foundation for broader efforts to determine the causes and consequences of violence — and the most effective prevention strategies. Specific studies of violence against women should continue to be carried out, however, to increase understanding of offenses that affect more women than men.

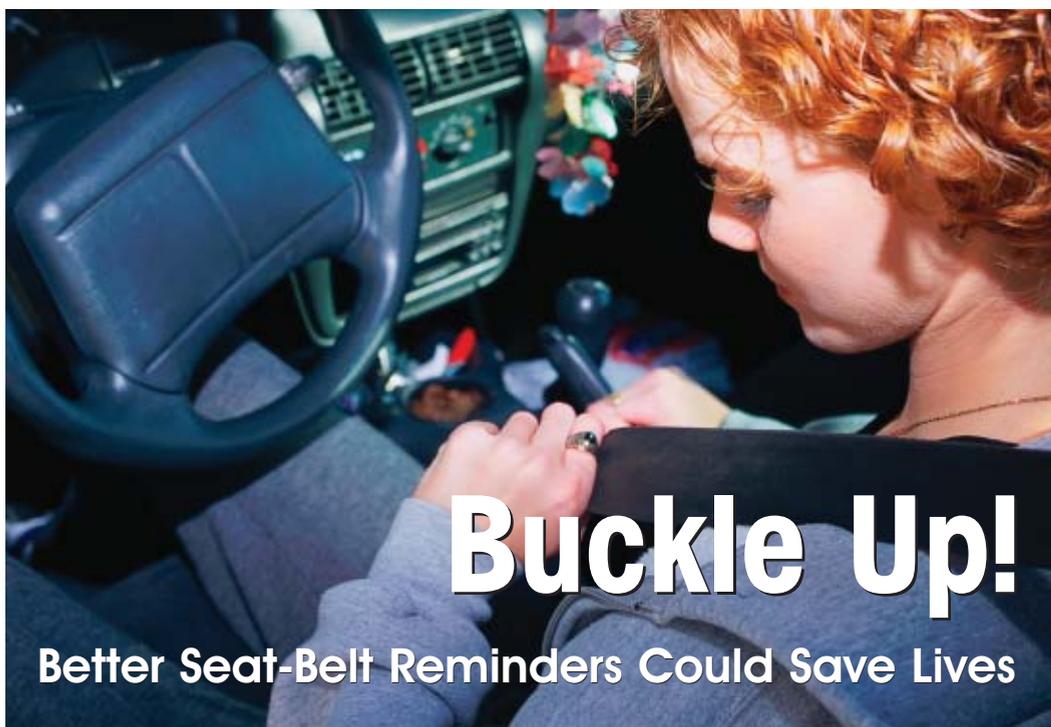
Scientists also should explore the influence of social factors such as relationship

dynamics, neighborhood conditions, and access to local preventive services on violent behavior, the report says. Both men and women who violently abuse intimate partners often have childhood histories of serious behavior problems, recent studies show. But male abusers are more likely as adults to commit violent crimes outside of intimate relationships.

Trying to figure out how well prevention and treatment strategies actually work is often difficult, the report points out. Data-collection efforts to determine the actual scope of the problem, as well as studies to assess intervention methods, are seldom consistent. And evaluations typically are underfunded and short on scientific rigor. Congress should fund the development of better data-collection systems and high-quality, long-term evaluations of prevention and treatment programs aimed at reducing violence against women. The National Institutes of Health and the U.S. Department of Justice should work together to carry out such a research project, with the goal of ultimately improving women's safety in American society. — *Vanee Vines*

■ **Advancing the Federal Research Agenda on Violence Against Women.** Steering Committee for the Workshop on Issues in Research on Violence Against Women, Committee on Law and Justice, Division of Behavioral and Social Sciences and Education (2004, 116 pp.; ISBN 0-309-09109-8; available from the National Academies Press, tel. 1-800-624-6242; \$35.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10849.html>).

The steering committee was chaired by **Candace M. Kruttschnitt**, professor, department of sociology, University of Minnesota, Twin Cities. The study was sponsored by the U.S. Department of Justice.



Buckle Up!

Better Seat-Belt Reminders Could Save Lives

Using seat belts is one of the most effective ways to avoid death or injury in a car crash. Yet a quarter of American passenger vehicle drivers still don't fasten their belts all the time even though this simple act could reduce their risks of fatal injury by about 45 percent in cars and by about 60 percent in light trucks, according to the National Highway Traffic Safety Administration.

The National Highway Traffic Safety Administration estimates that \$26 billion could be saved annually in medical care, lost productivity, and other injury-related costs if current non-users buckled up. It has also determined that with each percentage point increase in seat-belt use nationally, 250 lives could be saved every year.

NHTSA should encourage the automotive industry to expedite the deployment of enhanced belt reminder systems to help remedy the situation, says a new report from the Transportation Research Board. Also, Congress should amend the law that prohibits NHTSA from requiring reminder systems other than a 4- to 8-second belt reminder, which the report says has proved to be ineffective.

“In the short term, car manufacturers should voluntarily provide longer or louder seat-belt reminders for front-seat occupants

on all cars, sport utility vehicles, pickup trucks, and vans,” said William C. Howell, an adjunct professor at Arizona State University in Gold Canyon and chair of the committee that wrote the report. “Also, rear-seat reminder systems should be developed as soon as possible.”

Rear-seat reminder systems appear more costly than front-seat systems because of the absence of rear-seat sensors on many vehicles, installation complexities such as removable seats and child seats, and low rear-seat occupancy rates. For now, manufacturers should provide cheaper systems that notify the driver if riders are not buckled in, while working to develop reminder systems for rear-seat passengers themselves, the report says.

The only long-duration reminder system currently deployed in the United States, called BeltMinder, was developed by Ford Motor Co. It consists of warning chimes and flashing lights that operate intermittently for up to five minutes. Preliminary research on this system has found a 7 percent increase in seat-belt use. Other car manufacturers are expected to introduce similar systems in 2004 and 2005 passenger vehicles.

NHTSA should monitor the introduction of new belt reminder systems in the marketplace and study the effectiveness of different systems, the report says. For example, NHTSA should examine the loudness, duration, and cycling of the chime; the desirability of muting the radio when the chime is sounding; and whether users should be allowed to disable the system. Congress should give NHTSA about \$5 million annually to support this effort, which ought to help establish the scientific basis for regula-

tion of belt reminders, should regulation prove necessary.

Also, NHTSA and the private sector should encourage research and development of locking systems for specific applications, the committee said. For example, systems that prevent the vehicle from being put into gear if passengers don't buckle up could be considered by the courts for convicted drunk drivers or drivers with many tickets for speeding and other offenses. Locking systems also could be made available for teenage drivers, and insurance companies could opt to lower premium rates for young drivers who use such systems. Locking systems also could be installed on company fleets of vehicles.

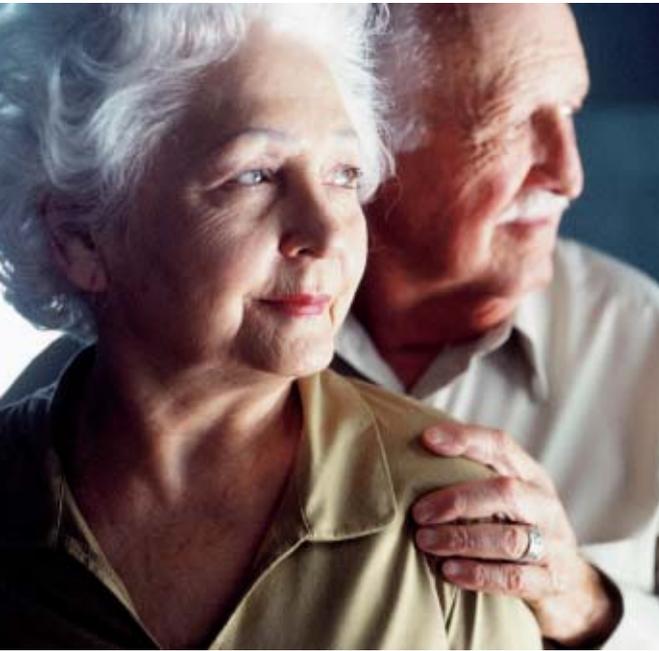
An independent review of seat-belt-use technologies should be conducted in five years to evaluate progress and consider revisions in strategies to achieve further gains, the report says.

“The modest additional costs of installing these systems and the annual \$5 million budget to conduct the recommended research are a small price to pay for the lives saved and the many hundreds of thousands of injuries prevented,” Howell said.

— *Patrice Pages*

■ ***Buckling Up: Technologies to Increase Seat Belt Use*** — **Special Report 278**. Committee for the Safety Belt Technology Study, Transportation Research Board (2003, approx. 100 pp.; ISBN 0-309-08593-4; available on the Internet at <books.nap.edu/catalog/10832.html>).

William C. Howell, adjunct professor, Arizona State University, Gold Canyon, chaired the committee. The study was funded by the U.S. Department of Transportation's National Highway Traffic Safety Administration.



Using **SCIENCE** to Aid **SENIORS**

New Technologies Can Ease Challenges of Advanced Age

Your gray hair is showing, America.

The size of the nation's elderly population grows each year. And millions of baby boomers are now contemplating retirement and how their lives will differ in old age.

Senior citizens have attracted intense interest in the scientific and engineering communities, which have sought innovative ways to apply technology to accommodate physical and mental changes that often mark aging. The goal is to develop devices that can assist older adults with everyday tasks and activities, improving their quality of life and supporting independent living. Although some products are already on the market, more research is needed to determine which potential applications would best fit the needs of older people, says a new report from the National Research Council.

The next stage of research needs a stronger focus on collaborative projects among experts in the fields of aging, user-friendly design, and engineering. In addition, it must take into account the specific needs of older adults when it comes to communication, employment, health, education,



housing, and transportation, the report says. Policy-makers and researchers also should explore effective approaches to get useful products quickly to market.

The report, which stems from a workshop held last year at the Academies, looks at several aging-related technologies that have moved from the lab to assembly lines, or are close to doing so. For instance, computer systems have been developed to allow people with severe motor impairments — such as those who have suffered strokes — to operate computers with their eyes. Tracking systems now available can help people locate lost objects within their homes. Mobile communication and computing devices, known as MCCDs, can combine features currently available in cell phones and personal digital assistants, plus run an increasingly sophisticated range of software. In the future, MCCDs will have the power to provide geographical cues

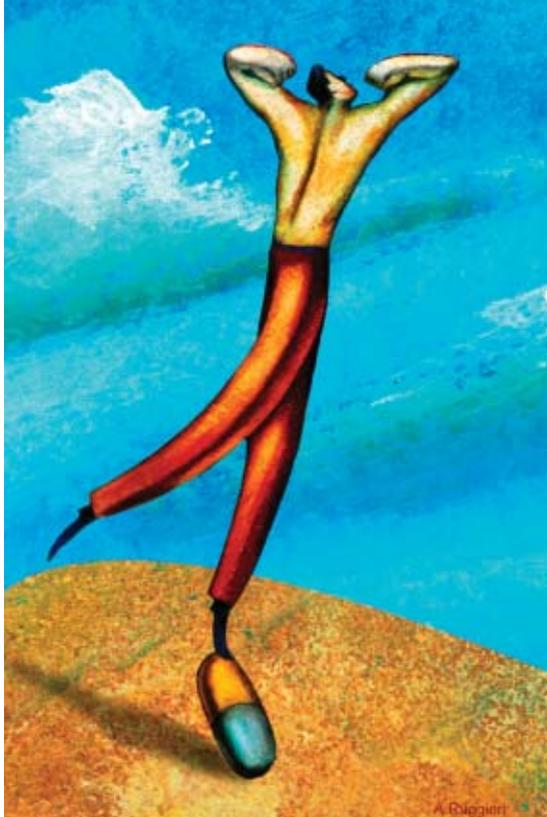
and other information from global positioning systems to make up for users' memory lapses while traveling. And some of these gadgets will be able to transmit data from medical sensors worn on a person's body to remote monitors, providing caregivers and older adults themselves with a stream of vital information in real time.

But challenges remain in the development and use of innovative devices, the report notes. Communication technologies traditionally have been designed by young engineers targeting young consumers. Also, issues of data privacy need to be tackled.

The report calls on the National Institute on Aging to support research aimed at designing useful technologies for this population. NIA also should back studies that investigate how aging affects the quality of life under natural conditions — not solely studies of people in tightly controlled laboratory tests. Furthermore, NIA should support long-term research on how older people's interactions with new technologies change over time. — *Vanee Vines*

■ **Technology for Adaptive Aging: Report and Papers.** Steering Committee for the Workshop on Technology for Adaptive Aging, Board on Behavioral, Cognitive, and Sensory Sciences, Division of Behavioral and Social Sciences and Education (2004, 320 pp.; ISBN 0-309-09116-0, 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 <books.nap.edu/catalog/10857.html>).

The steering committee was chaired by **Richard W. Pew**, principal scientist, BBN Technologies, Cambridge, Mass. The study was supported by the National Institutes of Health.



TESTOSTERONE AND AGING

Men's 'Fountain of Youth' Drug Needs More Study

Fatigued? Depressed? Flagging libido?
Is a testosterone boost all you need?
Hundreds of thousands of men think
so, as the rapidly rising number of
testosterone therapy prescriptions
written each year attests.

Despite its popularity, testosterone therapy has not been officially approved to treat conditions associated with decreasing levels of the hormone in aging men. Moreover, it has not been rigorously studied to determine if it can have these positive effects without triggering health problems.

A proposed large-scale clinical study of testosterone therapy for treating age-related conditions in older men was put on hold in 2002 until a committee of the Institute of Medicine could assess what is known about the therapy's benefits and risks and offer its guidance on the best way to proceed with such studies.

The verdict? "We really don't know much at all about normal levels of testosterone at different ages, how decreased testosterone levels affect men's health, and

whether this therapy might increase the risk of prostate cancer or other health problems,” said committee chair Dan Blazer, professor of psychiatry and behavioral sciences, Duke University Medical Center, Durham, N.C. “There have been only 31 randomized clinical trials of testosterone therapy in men ages 65 and older, and just one lasted longer than a year. Those studies simply have not provided enough evidence for men and their physicians to feel certain that the therapy really works and is safe.”

The report proposes a stepwise approach to conducting the clinical studies needed to ascertain the risks and benefits. The first step should be to firmly establish the therapy’s effectiveness in treating age-related conditions, which can be done with smaller trials. The committee estimated that several hundred older men would need to be monitored for one to two years. If clear efficacy is demonstrated in the initial studies, then the next step should be a large-scale trial involving several thousand men followed over a longer time frame.

The trials should involve only older men — that is, 65 and older — who have clinically low testosterone levels and at least one symptom that might be related to low testosterone. This is the population most likely to benefit from the therapy. The committee acknowledged that the majority of testosterone users are middle-aged men seeking to pre-empt the effects of aging.

However, it did not recommend studies focused on this age group because prostate cancer is a slow-growing and often latent disease and the death rate is lower in those under 65, so clinical trials to

assess the risks for this population would have to be much larger and last many more years than those focused on older men.

Moreover, the committee discouraged healthy men from using the therapy as a means of trying to prevent possible future health conditions or to boost strength or mood, at least while the

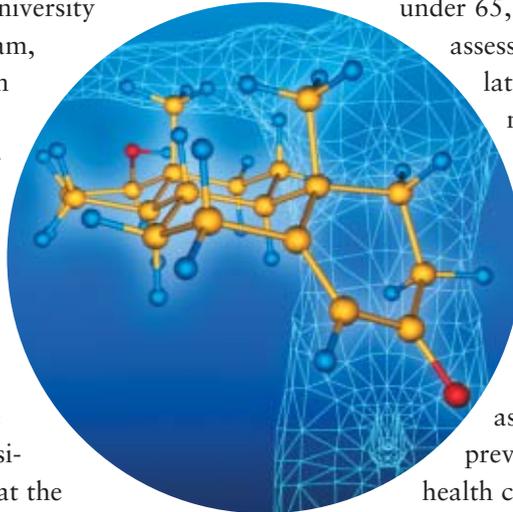
jury is still out on the risks and benefits. “For men whose testosterone is in the normal range, there is no proof that the therapy makes them better in any way,” said committee member Deborah Grady, professor of epidemiology, biostatistics, and medicine, University of California, San Francisco. “If there is no proven benefit for them, they shouldn’t be taking testosterone.”

— *Christine Stencel*

■ **Testosterone and Aging: Clinical Research Directions.**

Committee on Assessing the Need for Clinical Trials of Testosterone Replacement Therapy, Board on Health Sciences Policy, Institute of Medicine (2004, 240 pp.; ISBN 0-309-09063-6; available from the National Academies Press, tel. 1-800-624-6242; \$37.95 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10852.html>)

The committee was chaired by **Dan Blazer**, professor of psychiatry and behavioral sciences, Duke University Medical Center, Durham, N.C. The study was funded by the National Institute on Aging and the National Cancer Institute.



How Nurses Work

A Key Factor in Patient Safety

Nurses serve as the front line of defense against medical errors, often catching mistakes — such as inaccurate drug doses — before they reach patients. But because of inefficient work processes, inadequate staffing levels, and other systemic problems, nurses also cause or contribute to medical mishaps.

A great deal of attention has focused on the nationwide nursing shortage and the hours that nurses and other health professionals work. However, a recent report by the Institute of Medicine dispels the notion that there is a single “magic bullet” solution to reducing errors.

“Making sure that there are enough nurses on duty and that they are not working overly long hours certainly are important steps, but no one or two actions by themselves can improve patient safety,” said Donald Steinwachs, chair of the committee that wrote the report, and chair, department of health policy and management, Bloomberg School of Public Health, Johns Hopkins University, Baltimore. “Keeping patients safe requires fundamental changes in the organization of nurses’ work, how they are deployed, their involvement in management and decision-making, and how health care organizations understand and act on safety.”

In addition to recommending that nurses’ work hours be limited to no more than 12 per day and that report cards on nursing homes and hospitals include information on their nursing staff levels, the report calls on regulators and health care organizations to devise strategies to reduce the onerous burden of paperwork and documentation, which



consumes up to 28 percent of registered nurses’ time in hospitals.

To restore trust among

nurses that was eroded during health care restructuring initiatives begun in the mid-1980s, the report urges health care organizations to involve nurse leaders in all levels of management and to solicit input from nursing staff on decisions about work design and implementation. Nurses are in prime positions to help pinpoint inefficient work processes that could contribute to errors, identify causes of staff turnover, and determine appropriate staff levels for each unit. In addition, organizations should dedicate a portion of their budget to helping nurses maintain and acquire new knowledge and skills through ongoing training programs.

Although the nursing shortage makes it seem difficult to implement some of the report’s recommendations, the committee urges immediate action. “Because the supply of nurses is unfortunately stretched thin right now, they must be supported by a system that better defends against errors and readily detects and mitigates them when they occur.”

— *Christine Stencel*

■ **Keeping Patients Safe: Transforming the Work Environment for Nurses.** Committee on the Work Environment for Nurses and Patient Safety, Board on Health Care Services, Institute of Medicine (2004, 488 pp.; ISBN 0-309-09067-9; available from the National Academies Press, tel. 1-800-624-6242; \$44.95 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10851.html>).

The committee was chaired by **Donald Steinwachs**, chair, department of health policy and management, Bloomberg School of Public Health, Johns Hopkins University, Baltimore. The study was funded by the Agency for Healthcare Research and Quality of the U.S. Department of Health and Human Services.



EXPLORATION OF THE DEEP BLUE SEA

Unveiling the Ocean's Mysteries

The oceans cover nearly three-quarters of the Earth's surface, regulate our weather and climate, and sustain a large portion of the planet's biodiversity, yet we know very little about them. In fact, most of this underwater realm remains unexplored.

Three recent reports from the National Research Council propose a significantly expanded international infrastructure for ocean exploration and research to close this knowledge gap and unlock the many secrets of the sea.

Already a world leader in ocean research, the United States should lead a new exploration endeavor by example. "Given the limited resources in many other countries, it would be prudent to begin with a U.S. exploration program that would include foreign representatives and serve as a model for other countries," said John Orcutt, the committee chair for one of the reports and deputy director, Scripps Institution of

Oceanography, University of California, San Diego. "Once programs are established elsewhere, groups of nations could then collaborate on research and pool their resources under international agreements."

Using new and existing facilities, technologies, and vehicles, proposed efforts to understand the oceans would follow two different approaches. One component dedicated to exploration would utilize ships, submersibles, and satellites in new ways to uncover the ocean's biodiversity, such as the ecosystems associated with deep-sea hydrothermal vents, coral reefs, and volcanic, underwater mountains.

A second component — a network of ocean "observatories" composed of moored buoys and a system of telecommunication cables and nodes on the seafloor — would complement the existing fleet of research ships and satellites. The buoys would provide information on weather and climate as

well as ocean biology, and the cables would be used to transmit information from sensors on fixed nodes about volcanic and tectonic activity of the seafloor, earthquakes, and life on or below the seafloor.

Also, a fleet of new manned and unmanned deep-diving vehicles would round out this research infrastructure.

Education and outreach should be an integral part of new ocean science efforts by bringing discoveries to the public, informing government officials, and fostering collaborations between educators and the program's scientists, the reports say.

These activities will expand previous international programs. For example, the observatory network will build on current attempts to understand the weather, climate, and seafloor, such as the Hawaii-2 Observatory — which consists of marine telephone cables running between Oahu and Hawaii and the California coast — and the Tropical Atmosphere Ocean Array, which contains about 70 moorings in the Pacific and was key to predicting interannual climate events such as El Niño.

The National Oceanographic Partnership Program, an existing collaboration of 14 federal agencies, would be the most appropriate organization to house the ocean exploration program, which would cost approximately \$270 million the first year, and about \$100 million annually thereafter, according to the Research Council. The National Science Foundation is expected to fund the observatory network program, which would cost about \$25 million per



year, and provide funds for the construction and operation of at least one new manned submersible and possibly several remotely operated vehicles.

“Over the next decade, new international collaborations dedicated to ocean exploration and research will most likely lead to

new discoveries that could increase public awareness of the oceans as a common global bond, highlighting their importance in our lives,” Orcutt said.

— *Patrice Pages & Bill Kearney*

■ **Enabling Ocean Research in the 21st Century: Implementation of a Network of Ocean Observatories.**

Committee on Implementation of a Seafloor Observatory Network for Oceanographic Research, Ocean Studies Board, Division on Earth and Life Studies (ISBN 0-309-08990-5; \$49.00 plus \$4.50 shipping for single copies). The committee was chaired by **Robert S. Detrick Jr.**, chair, department of geology and geophysics, Woods Hole Oceanographic Institution, Woods Hole, Mass. The study was funded by the National Science Foundation.

■ **Exploration of the Seas: Voyage Into the Unknown.**

Committee on Exploration of the Seas, Ocean Studies Board, Division on Earth and Life Studies (ISBN 0-309-08927-1; \$45.00 plus \$4.50 shipping for single copies). The committee was chaired by **John Orcutt**, professor of geophysics and deputy director, Scripps Institution of Oceanography, San Diego. The study was funded by the National Oceanic and Atmospheric Administration.

■ **Future Needs in Deep Submergence Science: Occupied and Unoccupied Vehicles in Basic Ocean Research.**

Committee on Future Needs in Deep Submergence Science, Ocean Studies Board, Division on Earth and Life Studies (ISBN 0-309-09114-4; \$27.00 plus \$4.50 shipping for single copies). **John Armstrong**, retired vice president of science and technology at IBM, Amherst, Mass., chaired the committee. The study was funded by the National Science Foundation, NOAA, and the U.S. Navy.

The reports are available from the National Academies Press, tel. 1-800-624-6242; also on the Internet at <books.nap.edu>.



FROM COAST TO COAST

Endangered Fish in Pacific Northwest and Maine Face Similar Hurdles to Recovery

A National Research Council committee has weighed in for the second time on one of the nation's most contentious battles over water rights. A few years ago, federal officials became concerned that the water levels in Oregon's Upper Klamath Lake and low flows on the Klamath River, which runs from the lake through northern California, were causing further harm to already endangered and threatened fish. Subsequently, water for irrigation was severely restricted, pitting farmers who depend on the water for crops against the tribes of the upper and lower Klamath basins who have fished the lake and river for centuries. The decision to limit water for farming was reversed two years ago, however, when the Research Council committee's first report found insufficient scientific evidence to back the need for higher water levels or flows.

In a second report issued last fall, the committee maintained its skepticism of more stringent restrictions on irrigation water as an effective means to protect the fish — two species of suckers in the lake and coho salmon in the river. It said the federal agencies involved should instead focus more

on other causes of harm, such as excessive algae growth that depletes oxygen in the lake, dams that block spawning migrations, competition from hatchery fish, and high summer water temperatures.

The committee called for a new fish recovery plan that takes a broader ecosystem-wide approach, to be issued by the federal government within two years. The 12-foot-high Chiloquin Dam, in particular, should be removed because it blocks access to as much as 90 percent of the spawning habitat for suckers above the lake. The suckers may also benefit from adding oxygen to the lake, which should be tried on a trial basis, the report says. To lower the temperature of tributary water in the summer, which is probably the biggest threat to coho salmon, cool water should be procured through the purchase, trading, or leasing of groundwater, and woody vegetation should be restored along banks to provide shade. And hatcheries may need to alter their operations or even close if it is shown that hatchery fish lower the wild coho's chances of survival.

To guide recovery teams that will administer research and monitoring efforts,

a master plan should be developed and be reviewed periodically by outside experts. The committee estimated that it will cost between \$25 million and \$35 million over the next five years to implement the report's recommendations, excluding costs for major projects like dam removal.

Looking to the opposite side of the country, another Research Council committee has issued a report that says urgent action is needed if Maine's seriously depleted Atlantic salmon are to be rehabilitated. As is the case in the Klamath basin, removing dams would help, especially where removal would make the most spawning and rearing habitat available. And scientists should experiment with adding lime to rivers to offset acidity that may be killing young salmon trying to reach the ocean.

The committee questioned whether hatcheries in Maine are doing more harm

than good. It said that using hatcheries to boost the salmon population remains an unproven strategy and they should be used sparingly until more is known. Hatcheries should mainly provide a secure environment for wild salmon, which remain genetically distinct despite years of mingling with millions of hatchery salmon and an unknown number of escaped farm salmon, the report says. In addition, streams should not be stocked with hatchery salmon or non-native fish that crowd out wild salmon or deplete their food supply.

The state's current prohibitions on commercial and recreational salmon fishing need to continue, added the committee, which also recommended a decision-making approach for the state to follow in which stakeholders participate. — *Bill Kearney*

■ ***Endangered and Threatened Fishes in the Klamath River Basin: Causes of Decline and Strategies for Recovery.*** Committee on Endangered and Threatened Fishes in the Klamath River Basin, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (ISBN 0-309-09097-0; \$54.95 plus \$4.50 shipping for single copies). The committee was chaired by **William M. Lewis Jr.**, professor and director, Center for Limnology, Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder. The study was funded by the Bureau of Reclamation and Fish and Wildlife Service at the U.S. Department of the Interior, and the National Marine Fisheries Service at the U.S. Department of Commerce.

■ ***Atlantic Salmon in Maine.*** Committee on Atlantic Salmon in Maine, Board on Environmental Studies and Toxicology and Ocean Studies Board, Division on Earth and Life Studies (ISBN 0-309-09135-7; \$55.00 plus \$4.50 shipping for single copies). The committee was chaired by **M.T. Clegg**, professor of genetics, University of California, Riverside. The study was funded by the U.S. Department of the Interior and the National Fish and Wildlife Foundation.

Both reports are available from the National Academies Press, tel. 1-800-624-6242; also on the Internet at <books.nap.edu>.



Building S&T Capacity Around the World

The InterAcademy Council (IAC), an organization created by 90 of the world's science academies, released its first study in February at a United Nations ceremony hosted by Secretary-General Kofi Annan. The report, *Inventing a Better Future: A Strategy for Building Worldwide Capacities in Science and Technology*, recommends that every nation, whether industrialized or developing, work to enhance its own S&T



capacity in consultation with national scientific, engineering, medical, and industrial communities.

Challenges such as stimulating economic growth, mitigating environmental problems, and responding quickly to sudden outbreaks of new diseases all require that such capacity already be in place, the report says. In the case of developing countries, national strategies need to reflect local priorities, spell out

adequate sources of funding, and emphasize regional cooperation.

These and other findings were laid out by Jacob Palis, a professor at the Instituto Nacional de Matemática Pura e Aplicada in Brazil, and Ismail Serageldin, director of the Bibliotheca Alexandrina in Egypt, who co-chaired a study panel of experts from 11 countries that wrote the report.

At the ceremony in New York City, NAS President Bruce Alberts — who co-chairs the IAC with Goverdhan Mehta, past president of the Indian Academy of Sciences — formally presented the report to the secretary-general. Mark Malloch Brown, administrator of United Nations Development Programme, moderated a question-and-answer session with representatives from the U.N. member delegations. And Mamphela Ramphele, managing director at the World Bank and a member of the study panel, spoke about next steps to implement the report's findings.

The InterAcademy Council, headquartered at the Royal Netherlands Academy of Arts and Sciences in Amsterdam, was formed in 2000 to mobilize the world's best scientists to provide expert knowledge to international bodies. Future IAC reports will focus on such topics as agricultural productivity in Africa and global transitions to sustainable energy systems.

Inventing a Better Future is available free online at <www.interacademycouncil.net>.

— William Skane



New Initiative to Improve Public Health

While the Institute of Medicine is well-known for its expert advice and scholarly reports on health issues, much of this information is only distributed to a limited group of policy-makers and interested parties. Many recommendations that would help underserved and disadvantaged communities are often not readily accessible to the very communities they strive to help.

To change this, the Institute of Medicine has initiated the Kellogg Health of the Public Fund. The fund was made possible by an initial grant of \$2.5 million from the W.K. Kellogg Foundation, as well as a commitment to match up to \$2.5 million in additional funds raised by the Institute.

The \$7.5 million endowed fund will allow IOM to develop pamphlets, CD-ROMs, videos, online publications, and other tools to increase the accessibility of a wealth of health information. The endowment will also enable the Institute to organize regional and local forums, training programs, community meetings, and other events in partnership with community health organizations.

“The Kellogg Health of the Public Fund will support Institute communication and dissemination activities that will have the greatest impact in creating healthy communities, particularly in areas that traditionally have been underserved and have had little

access to high-quality health services and information about public health,” said IOM President Harvey V. Fineberg.

“A public that is fully informed and empowered to make decisions about health and health care is essential for the nation’s well-being, and the Institute of Medicine is the ideal organization to take a leading role in getting scientifically validated health



information out to public health professionals and communities,” said William Richardson, president and CEO of the Kellogg Foundation.

The W.K. Kellogg Foundation of Battle Creek, Mich., was established in 1930 to help people help themselves through the practical application of knowledge and resources to improve their quality of life and that of future generations. For information on how to make a gift in support of IOM’s Kellogg initiative, contact Bruce G. Flynn at tel. 202-334-2431 or e-mail <bfflynn@nas.edu>.

—Heather A. McDonald

Kick-Off Conference a Success

*Keck Futures Conference Draws Top Researchers,
Announces \$825,000 in Grants*

More than 100 researchers gathered at the first National Academies Keck *Futures Initiative* conference. Titled “Signals, Decisions, and Meaning in Biology, Chemistry, Physics, and Engineering,” the conference attracted scientists, engineers, and medical researchers to explore the theme of signaling, its diverse

manifestations in a variety of fields, and interdisciplinary connections. To encourage further activity in this direction, the Academies announced the availability of seed grants — up to \$75,000 each — that will be awarded to nearly a dozen of the researchers who attended the conference.

“Interdisciplinary collaborations that bring together the perspectives and approaches from different fields of science and engineering will spur new kinds of discoveries,” said NAS President Bruce Alberts.

“It is at gatherings such as the *Futures* conference that the barriers between disciplines are broken down, transforming the landscape of future research. The theme for our

next conference will be nanotechnology.”

The conference, held last November in Irvine, Calif., was the first of a series to address topics where disciplines intersect. In addition to discussions led by expert panels, the conference featured sessions where researchers, along with representatives from funding agencies, universities, and the news media, explored ways to stimulate new interdisciplinary research.

Also, to support signaling research that might not otherwise happen, the newly available \$825,000 in grant money will be distributed among up to 11 conference participants. A total of \$135,000 is available as well, to support up to three follow-up conferences. Grant recipients will be announced in April 2004.

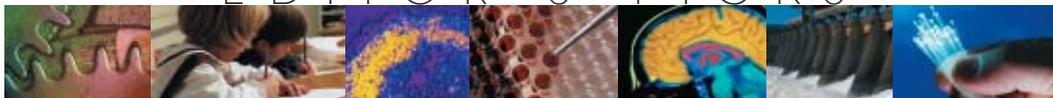
During the conference, the National Academies held an awards ceremony for the first recipients of the National Academies Communication Awards — *Eye of the Albatross* author Carl Safina, *New York Times* reporter Andrew Revkin, and National Public Radio correspondent Joe Palca. The awards recognize excellence in communicating science, engineering, and medicine to the public.

The National Academies Keck *Futures Initiative*, which was launched last year, is a 15-year effort to catalyze interdisciplinary inquiry and research, and enhance communication among researchers, funding agencies, universities, and the general public. For more information on the initiative, visit <www.national-academies.org/keck>

— Maureen O’Leary



EDITOR'S PICKS



From the National Academies' Web Site

Strong Web Presence

Each month, the National Academies host hundreds of thousands of online visitors, and the numbers continue rising. Both the National Academies and the National Academies Press home pages recently attained Google PageRanks of 10 out of a possible 10. This perfect score is key to being listed on or near the first page in Google's search results, and it is determined by a site's online significance, respectability, and value. The Academies attribute this achievement to exceptionally valuable content that is constantly refreshed; an optimized search engine; strong site-wide linking initiatives; and increased Web visibility. www.national-academies.org and www.nap.edu

Science Museum Opens

The Marian Koshland Science Museum, a new museum exploring the links between scientific research and everyday life, will open on April 23 at the National Academies' Keck Center in Washington, D.C. The museum will be the only one in the nation's capital solely dedicated to exploring science at the core of public policy decisions, with inaugural exhibits offering a glimpse of today's scientific frontiers. www.koshland-science-museum.org

Internet Safety

The Academies has launched NetSafeKids, an authoritative Web site that examines the issues surrounding pornography and sexual predators on the Internet. The site offers essential information and practical tips that will help parents and adults make more informed decisions about how children spend time online.

www.netsafekids.org

Science Journal

Proceedings of the National Academy of Sciences is one of the world's most-cited multidisciplinary scientific serials. Since 1914, it has published cutting-edge research, commentaries, reviews, perspectives, colloquium papers, and actions of the Academy. The journal spans the biological, physical, and social sciences. *PNAS* is published biweekly in print, and daily online in *PNAS Early Edition*. *PNAS Online* receives nearly 4 million hits per month.

www.pnas.org

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Projects

The following projects have been recently undertaken by units of the National Academies. The latest information about all current committee activities — including project descriptions, committee rosters, and meeting information — is available in “Current Projects” on the National Academies’ Web site.

Advances in Technology and the Prevention of Their Application to Next Generation Biowarfare Agents.

Board on Development, Security, and Cooperation, Division on Policy and Global Affairs; and Board on Global Health, Institute of Medicine. Project director: Eileen Choffnes. Co-chairs: Stanley Lemon, dean, School of Medicine, University of Texas Medical Branch, Galveston; and David Relman, associate professor of medicine and of microbiology and immunology, Stanford University, Stanford, Calif. Sponsors: Information Technology Innovation Center, National Science Foundation, Food and Drug Administration, National Institute of Allergy and Infectious Diseases, and the U.S. Department of Homeland Security.

Assessing the Nation’s Framework for Addressing Animal Diseases.

Board on Agriculture and Natural Resources, Division on Earth and Life Studies. Project director: Tina Rouse. Chair: Lonnie J. King, dean, College of Veterinary Medicine, Michigan State University, East Lansing. Vice chair: Margaret A. Hamburg, vice president for biological programs, Nuclear Threat Initiative, Washington, D.C. Sponsor: The National Academies, with funds from an endowment from the W.K. Kellogg Foundation.

Assessing Technological Literacy in the United States.

National Academy of Engineering, and Board on Testing and Assessment, Division of Behavioral and Social Sciences and Education. Project director: Greg Pearson. Chair: Elsa Garmire, Sydney E. Junkins Professor of Engineering, Thayer School of Engineering, Dartmouth College, Hanover, N.H. Sponsor: National Science Foundation.

Cancer Control in Low- and Middle-Income Countries.

Board on Global Health, Institute of Medicine; and National Cancer Policy Board, Institute of Medicine and National Research Council. Project director: Hellen Gelband. Chair: To be selected. Sponsors: National Cancer Institute and American Cancer Society.

Health Implications of Perchlorate Ingestion.

Board on Environmental Studies and Toxicology, Division on Earth and Life Studies; and Board on Health Sciences Policy, Institute of Medicine. Project director: Ellen Mantus. Chair: Richard Johnston Jr., associate dean for research development, and professor, department of pediatrics, University of Colorado School of Medicine and National Jewish Medical and Research Center, Denver. Sponsors: U.S. Environmental Protection Agency, U.S. Department of Defense, U.S. Department of Energy, and NASA.

Standards and Policies for Decontaminating Public Facilities Affected by Exposure to Harmful Biological Agents: How Clean is Safe?

Board on Life Sciences, Division on Earth and Life Studies. Project director: Kerry Brenner. Chair: Kenneth Berns, director, Genetics

Institute, and professor of molecular genetics and microbiology, University of Florida, Gainesville. Sponsor: U.S. Department of Homeland Security.

Test Design for K-12 Science Achievement.

Board on Testing and Assessment, Division of Behavioral and Social Sciences and Education. Project director: Meryl Bertenthal. Chair: Mark Wilson, professor of policy, organization, measurement, and evaluation, Graduate School of Education, University of California, Berkeley. Sponsors: National Science Foundation and U.S. Department of Education.

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. Prices and availability of all documents are subject to change. Charges listed are for single copies; discounts are available for bulk orders.

Advancing Prion Science: Guidance for the National Prion Research Program

Medical Follow-Up Agency, Institute of Medicine (2003, approx. 250 pp.; ISBN 0-309-09060-1; available from NAP, \$40.00 plus \$4.50 shipping).

Assessing Research-Doctorate Programs: A Methodology Study

Division on Policy and Global Affairs (2003, 164 pp.; ISBN 0-309-09058-X; available from NAP, \$35.00 plus \$4.50 shipping).

Assessment of Processing Gelled GB M55 Rockets at Anniston
Board on Army Science and Technology, Division on Engineering and Physical Sciences (2003, 70 pp.; ISBN 0-309-08997-2; available from NAP, \$18.00 plus \$4.50 shipping).

Biological Confinement of Genetically Engineered Organisms
Board on Agriculture and Natural Resources and Board on Life Sciences, Division on Earth and Life Studies (2004, approx. 236 pp.; ISBN 0-309-09085-7; available from NAP, \$42.95 plus \$4.50 shipping).

Biotechnology Research in an Age of Terrorism
Board on Development, Security, and Cooperation, Division on Policy and Global Affairs (2003, 180 pp.; ISBN 0-309-08977-8; available from NAP, \$36.00 plus \$4.50 shipping).

Conflict and Reconstruction in Multiethnic Societies — Proceedings of a Russian-American Workshop
Office for Central Europe and Eurasia, Board on Development, Security, and Cooperation, Division on Policy and Global Affairs (2003, 236 pp.; ISBN 0-309-08939-5; available from NAP, \$47.50 plus \$4.50 shipping).

Critical Issues in Weather Modification Research
Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2003, 144 pp.; ISBN 0-309-09053-9; available from NAP, \$35.00 plus \$4.50 shipping).

Dietary Reference Intakes: Guiding Principles for Nutrition Labeling and Fortification
Food and Nutrition Board, Institute of Medicine (2003, approx. 170 pp.; ISBN 0-309-09143-8; available from NAP, \$39.95 plus \$4.50 shipping).

Distribution and Administration of Potassium Iodide in the Event of a Nuclear Incident
Board on Radiation Effects Research, Division on Earth and Life Studies (2004, 262 pp.; ISBN 0-309-09098-9; available from NAP, \$39.00 plus \$4.50 shipping).

Elements of a Science Plan for the North Pacific Research Board — Interim Report
Ocean Studies Board and Polar Research Board, Division on Earth and Life Studies (2004, approx. 126 pp.; ISBN 0-309-09144-6; available from NAP, \$28.75 plus \$4.50 shipping).

Ensuring Environmental Health in Postindustrial Cities — Workshop Summary
Roundtable on Environmental Health Sciences, Research, and Medicine, Board on Health Sciences Policy, Institute of Medicine (2003, 96 pp.; ISBN 0-309-09061-X; available from NAP, \$18.00 plus \$4.50 shipping).

Evaluating Military Advertising and Recruiting: Theory and Methodology
Board on Behavioral, Cognitive, and Sensory Sciences, Division on Behavioral and Social Sciences and Education (2004, approx. 300 pp.; ISBN 0-309-09127-6; available from NAP, \$14.00 plus \$4.50 shipping).

Future Challenges for the U.S. Geological Survey's Mineral Resources Program
Board on Earth Sciences and Resources and Committee on Earth Resources, Division on Earth and Life Studies (2003, approx. 158 pp.; ISBN 0-309-08993-X; available from NAP, \$34.00 plus \$4.50 shipping).

Immunization Safety Review: Influenza Vaccines and Neurological Complications
Board on Health Promotion and Disease Prevention, Institute of Medicine (2004, 190 pp.; ISBN 0-309-09086-5; available from NAP, \$39.00 plus \$4.50 shipping).

Improving Birth Outcomes: Meeting the Challenge in the Developing World
Board on Global Health, Institute of Medicine (2003, 372 pp.; ISBN 0-309-08614-0; available from NAP, \$49.00 plus \$4.50 shipping).

Improving Racial and Ethnic Data on Health — Report of a Workshop
Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2004, 58 pp.; ISBN 0-309-09094-6; available from NAP, \$18.00 plus \$4.50 shipping).

Improving the Characterization Program for Contact-Handled Transuranic Waste Bound for the Waste Isolation Pilot Plant
Board on Radioactive Waste Management, Division on Earth and Life Studies (2004, 144 pp.; ISBN 0-309-09090-3; available from NAP, \$39.00 plus \$4.50 shipping).

Improving the Regulation and Management of Low-Activity Radioactive Wastes — Interim Report on Current Regulations, Inventories, and Practices
Board on Radioactive Waste Management, Division on Earth and Life Studies (2003, 88 pp.; ISBN 0-309-52787-2; available at <www.nap.edu> as PDF file only, \$10.80).

Insuring America's Health: Principles and Recommendations
Board on Health Care Services, Institute of Medicine (2004, 224 pp.; ISBN 0-309-09105-5; available from NAP, \$27.00 plus \$4.50 shipping).

Issues and Opportunities Regarding the U.S. Space Program — A Summary Report of a Workshop on National Space Policy
Space Studies Board and Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences (2004, 92 pp.; ISBN 0-309-09146-2; available from NAP, \$18.00 plus \$4.50 shipping).

Learning and Instruction: A SERP Research Agenda
Panel on Learning and Instruction, Strategic Education Research Partnership, Division of Behavioral and Social Sciences and Education (2004, 176 pp.; ISBN 0-309-09081-4; available from NAP, \$39.95 plus \$4.50 shipping).

Measuring What Matters: Allocation, Planning, and Quality Assessment for the Ryan White CARE Act
Board on Health Promotion and Disease Prevention, Institute of Medicine (2004, 190 pp.; ISBN 0-309-09115-2; available from NAP, \$38.00 plus \$4.50 shipping).

National Need and Priorities for Veterinarians in Biomedical Research
Institute for Laboratory Animal Research, Division on Earth and Life Studies (2004, 102 pp.; ISBN 0-309-09083-0; available from NAP, \$24.75 plus \$4.50 shipping).

New Treatments for Addiction: Behavioral, Ethical, Legal, and Social Questions
Board on Behavioral, Cognitive, and Sensory Sciences, Division of Behavioral and Social Sciences and Education; and Board on Health Promotion and Disease Prevention and Board on Neuroscience and Behavioral Health, Institute of Medicine (2004, 324 pp.; ISBN 0-309-09128-4; available from NAP, \$47.00 plus \$4.50 shipping).

Owner-Authorized Handguns — A Workshop Summary
National Academy of Engineering (2003, 68 pp.; ISBN 0-309-08975-1; available from NAP, \$18.00 plus \$4.50 shipping).

Patient Safety: Achieving a New Standard for Care
Board on Health Care Services, Institute of Medicine (2004, approx. 400 pp.; ISBN 0-309-09077-6; available from NAP, \$44.95 plus \$4.50 shipping).

Reducing Birth Defects: Meeting the Challenge in the Developing World
Board on Global Health, Institute of Medicine (2003, 253 pp.; ISBN 0-309-08608-6; available from NAP, \$39.00 plus \$4.50 shipping).

Research Training in Psychiatry Residency: Strategies for Reform
Board on Neuroscience and Behavioral Health, Institute of Medicine (2003, 272 pp.; ISBN 0-309-09071-7; available from NAP, \$42.00 plus \$4.50 shipping).

Review of EPA Homeland Security Efforts: Safe Buildings Program Research Implementation Plan
Board on Chemical Sciences and Technology, Division on Earth and Life Studies (2003, 38 pp.; ISBN 0-309-09104-7; available from NAP, \$12.00 plus \$4.50 shipping).

Review of NASA's Aerospace Technology Enterprise: An Assessment of NASA's Aeronautics Technology Programs
Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences (2004, 144 pp.; ISBN 0-309-09119-5; available from NAP, \$32.00 plus \$4.50 shipping).

Review of the Centers for Disease Control and Prevention's Smallpox Vaccination Program Implementation: Letter Report #5
Board on Health Promotion and Disease Prevention, Institute of Medicine (2003, 42 pp.; available only online at <www.nap.edu>).

Review of the U.S. Army Corps of Engineers Upper Mississippi-Illinois Waterway Restructured Feasibility Study — Interim Report
Water Science and Technology Board, Division on Earth and Life Studies; and Transportation Research Board (2003, 45 pp.; ISBN 0-309-09133-0; available from NAP, \$12.00 plus \$4.50 shipping).

The Role of Environmental Hazards in Premature Birth — Workshop Summary
Roundtable on Environmental Health Sciences, Research, and Medicine, Board on Health Sciences Policy, Institute of Medicine (2003, 148 pp.; ISBN 0-309-09065-2; available from NAP, \$35.00 plus \$4.50 shipping).

Setting the Course: A Strategic Vision for Immunization — Part 4, Summary of the Washington, D.C., Workshop

Board on Health Care Services, Institute of Medicine (2003, 60 pp.; ISBN 0-309-09068-7; available from NAP, \$18.00 plus \$4.50 shipping).

Setting Priorities for Large Research Facility Projects Supported by the National Science Foundation

Committee on Science, Engineering, and Public Policy, The National Academies; and Board on Physics and Astronomy, Division on Engineering and Physical Sciences (2004, approx. 200 pp.; ISBN 0-309-09084-9; available from NAP, \$41.50 plus \$4.50 shipping).

The Sun to the Earth — and Beyond: Panel Reports

Space Studies Board, Division on Engineering and Physical Sciences (2003, 264 pp.; ISBN 0-309-08972-7; available from NAP, \$52.25 plus \$4.50 shipping).

Understanding Climate Change Feedbacks

Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2003, 166 pp.; ISBN 0-309-09072-5; available from NAP, \$35.00 plus \$4.50 shipping).

Where the Weather Meets the Road: A Research Agenda for Improving Road Weather Services

Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies; and Transportation Research Board (2004, 134 pp.; ISBN 0-309-09136-5; available from NAP, \$35.00 plus \$4.50 shipping).

HOT OFF THE PRESS

Degrees Kelvin

A Tale of Genius, Invention, and Tragedy

David Lindley

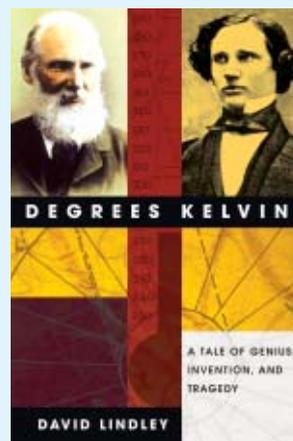
At a time when no one really understood heat, light, electricity, or magnetism, a young scholar named William Thomson found key connections between them, laying the groundwork for two of the cornerstones of 19th century science — the theories of electromagnetism and thermodynamics.

Charismatic, confident, and boyishly handsome, Thomson dazzled Victorian society. When others were flummoxed by their inability to adapt overland telegraphic cables to underwater, intercontinental use, Thomson took to the seas with new equipment that was to change the face of modern communications. And as the world's navies transitioned from wooden to iron ships, they looked to Thomson to devise a compass that would hold true. He was elevated to the peerage by Queen Victoria for his many achievements, the first scientist ever to be so honored.

But as the century drew to a close, the legendary scientific mind of Sir William Thomson — Lord Kelvin — began to weaken. Although his early mathematical prowess had transformed our understanding of the forces of nature, he would never truly accept the revolutionary changes he had helped bring about — it was others who took his ideas to their logical conclusions. In the end Thomson came to stand for all that was complacent and old in the world of 19th century science.

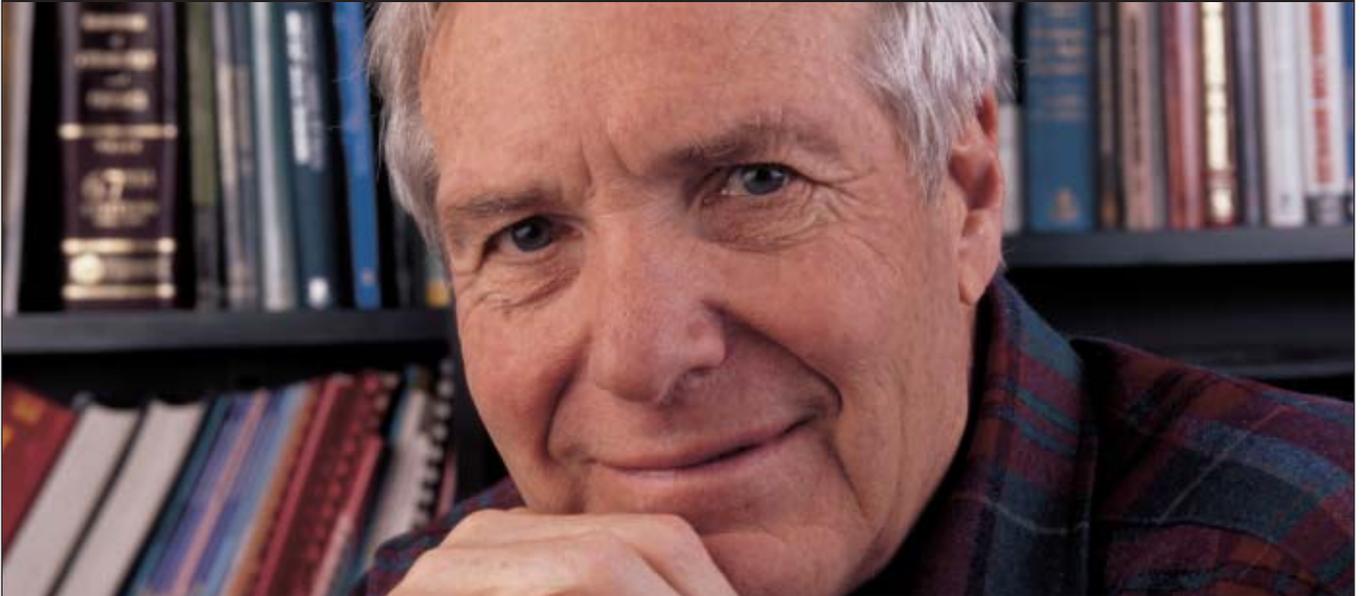
Destined to become the definitive biography of one of the most important figures in modern science, *Degrees Kelvin* presents a surprising and compelling portrait of a complex scientist.

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He's shaping the future **one mind at a time.**



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Through his Interdisciplinary Telecommunications Program at the University of Colorado at Boulder, Dr. Frank Barnes has helped shape many of the finest minds working in that field today. For his visionary efforts, Dr. Barnes has been awarded the National Academy of Engineering's 2004 Bernard M. Gordon Prize, given to an educator whose work in higher education fosters development of tomorrow's engineering leaders.

Learn more about Dr. Barnes' achievements – and submit your nominations for next year's Gordon Prize – at our website, www.nae.edu/awards.



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