The American Chemical Society's Award-Winning Publication

Chemistry

SPRING 2006

WASHBURN UNIVERSITY

Science Strange but True

T. rex's *speed is quick to grab your attention among these vignettes about the anomalies and curiosities of science* *page 36*

PUBLISHED BY THE AMERICAN CHEMICAL SOCIETY

chemistry.org/Chemistry

CONTENTS

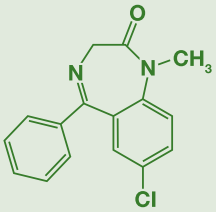
FEATURES

WHAT'S IN THE LOGO?

7-CHLORO-1,3-DIHYDRO-1-METHYL-5-PHENYL-2H-1,4-BENZODIAZEPIN-2-ONE

$C_{16}H_{13}ClN_2O$

Valium (diazepam) is among the medical innovations that emerged from work of the "two-legged rat" generation of chemists.
See Ask the Lab Rat, page 52.



DEPARTMENTS

Chemistry

Chemistry, published three times a year for American Chemical Society members, focuses on the science and people in chemistry.

Published by the Membership Division of ACS, a nonprofit scientific organization.

Chemistry is published for ACS members interested in learning more about the chemical sciences and ACS.

Readers' comments are welcomed and should be addressed to Michael Woods, *Chemistry* editor, Othmer–1210, ACS, 1155 16th St., NW, Washington, DC 20036, or e-mailed to chemistry@acs.org.

EDITORIAL

The old phrase "power behind the throne" refers to individuals, organizations, or technologies that are the real source of something very important.

In modern politics, it often means the low-profile aide, adviser, lobbyist, or spouse who sets policy by influencing or manipulating a political leader. Things were a lot less subtle in medieval times, by the way, when this figure of speech originated. The conniver stood behind the throne and openly whispered right into the ear of an indecisive or dim-witted king.

But "power behind" gets applied in other fields, wherever some hidden factor operates behind the scenes without getting the recognition or credit that it so richly deserves.

You can't help but read Patrick Young's article on imaging agents in this edition without thinking of chemistry's role as an often-unheralded power for good in modern society. As Young points out, chemistry is the science behind millions of diagnostic tests done with contrast agents, compounds that enhance the visibility of structures inside the body. Those tests save countless lives, improve the treatment of diseases, and reduce suffering.

Chemistry often is medicine's anonymous philanthropist. People see the gift. It's another "marvel of modern medicine," for instance, in the case of new diagnostic tests or medications. The public honors the physicians who use it. But few people connect the gift with the donors—chemists working behind the scenes in industry and academe.

And chemistry often is the anonymous benefactor for much of the rest of modern science, from astronomy to zoology. All too often, chemistry fails to get the credit for its role in technological advances, while taking the blame for the environmental consequences of technological progress.

Becky Ham's feature article in this edition points out that the fuzzy image is by no means limited to chemistry. The public sometimes gets a distorted image of other branches of science, and scientists in general, in popular television programming.

The ACS has pioneered a wide range of efforts to raise public awareness of chemistry's contributions. Those initiatives began in 1919, when ACS started its News Service to help the news media inform the public about chemistry. ACS often is credited with being the first scientific organization with a media relations department working to interpret science to the public.

And ACS's efforts continue today with a broad range of programs that are having a positive impact on public perceptions of chemistry and chemists.

With great pleasure—and some regret—I am joining those exciting efforts as a staff member at ACS headquarters in Washington, DC. Over the years, I've worked with ACS staff on freelance writing projects that ranged from brief news items to full-length books. I've gotten to know these individuals, and have admired and respected them as some of the very best in the business. I am honored to join them.

The regret? This transition will mean passing the editorship of *Chemistry* along to another individual. Editing *Chemistry* has been my favorite freelance project. I started in 1996 as editor of *Reaction Times,* the college chemistry newspaper that combined with *ACScope,* a membership publication, to become *Chemistry.* I'll always treasure memories as the first editor of *Chemistry*—memories of working with writers, copy editors, graphic designers, and staff in the ACS Membership Division.

Throughout that period, I've benefited greatly from my own "power behind." It came from members of the *Chemistry* advisory board (CAB) who have worked hard with great creativity behind *Chemistry's* scenes. (See the current CAB list, left.)

CAB members have originated topics for the stories that appeared in *Chemistry,* helped writers find the best sources, conducted line-by-line reviews of the content of every edition, and assisted in other ways. Like countless other members who volunteer for ACS service, their commitment may not always be visible, but it will remain invaluable as *Chemistry* continues its role as a source of information for ACS members. ⬢

Michael Woods

Michael Woods (ACS '96), editor of Chemistry, *is a science journalist and author in Washington, DC. His most treasured writing award is the ACS Grady-Stack Award for Interpreting Chemistry to the Public, named for News Service pioneers James T. Grady and James H. Stack.*

We (Should) Have Nothing To Fear

Concerns about competing in the global economy may be more widespread than anyone believes. The United States, however, has much to gain from global competition.

During three years as a columnist for *Chemistry,* I've been highlighting the benefits of studying and working overseas. But on a recent scuba diving vacation in the Caribbean, I met a chemist who got quite agitated when I told him that Global Perspectives encourages, well, that kind of global perspective.

He claimed that in this age of globalization, I was encouraging actions that would put the United States at a competitive disadvantage. In essence, he said that I was supporting economic treason by encouraging our best and brightest minds to use their talents to benefit our nation's competitors.

Now, I live in Colorado, and I hear similarly xenophobic comments all the time from one member of my state's congressional delegation. I was stunned, though, to hear that viewpoint from a world-traveling, tenured professor at a major university.

I want to respond to those kinds of comments here for two reasons: because I believe that they are wrong and symptomatic of a mind-set that may be quite prevalent. Only a few people may discuss this issue openly, but many more agonize over whether globalization threatens U.S. economic vitality.

Competing Globally

Simply put, it's the mind-set that the United States has something to fear about competing in the global economy, lots to lose from doing it, and little to gain. We should be afraid that jobs may move abroad. We should be afraid that the citizens of India, China, and other developing countries are starting to reap the benefits of expanded educational opportunities and investments in science and technology. We should be afraid that as science becomes more global, the United States will lose the competitive advantage that has driven its economy since the end of World War II.

President Franklin D. Roosevelt had it right when he cautioned, "The only thing we have to fear is fear itself." Instead of being pessimists and retreating from competition, let's rise up and respond to that challenge. In doing so, we can continue to grow our economy and create jobs for today and tomorrow while solving some of the great problems facing all the citizens of this planet.

A History of Competing Successfully

In the 1960s, when I was a schoolboy dreaming of finding a cure for cancer, the United States faced intense competition from the Soviet Union. Our response as a nation was to boost funding for education and scientific research. Our schools turned out National Merit Scholars by the bucketful, our universities became world leaders in chemistry, molecular biology, computer science, and virtually every other area of science. International cooperation and exchange became an integral part of doing science.

Yes, we had national priorities. We battled Communism, just as we now fight a war against terrorism. We had massive poverty to contend with, just as we now must address rapidly escalating health-care costs. But in the end, our leaders in the 1960s—just as President Roosevelt did in the 1930s—saw that intellectual capital was our greatest resource. They realized that using that capital was the surest way to becoming and staying a great economic power.

How do we square our history of achievement with today's inadequate funding of education—the machine that creates intellectual capital—and fears about globalization? We cannot. And if we continue with that mind-set, then perhaps my scuba diving acquaintance was correct. Perhaps we should be afraid.

Benefits of a Global Perspective

This era should be a time of excitement and optimism, when we welcome the challenges of globalization. Consider, for instance, all the abundance of bright young scientists-in-the-making that we have in this country, our strong scientific and technological infrastructure, the vibrant entrepreneurial spirit that spawned the biotechnology era, and that envy-of-the-world venture capital industry that's ready to jump-start the next technological revolutions.

With so many great opportunities ahead in nanotechnology, proteomics, chemical genetics, materials science, photochemistry, and other fields, our future in a global economy is much more likely to be bright than dismal. History once again teaches an important lesson. Over the past 50 years, chemistry has benefited tremendously from a flow of ideas and talent that crosses national boundaries. No country has a monopoly on knowledge and creativity. Different cultures have different approaches to solving problems and reaching goals.

By working abroad, American scientists can learn from other cultures and become more creative in translating ideas into new products. My scuba diving friend ignores the fact that American products must compete in the global marketplace. Scientists who have studied or worked abroad will have the knowledge and experience that it takes to develop and market successful products. ⬢

Joe Alper lived the life he writes about as Chemistry's *Global Perspectives columnist. He held jobs in London and Paris before returning to the United States and a career as a noted freelance science and medical writer based in Louisville, CO.*

FROM THE DESK OF THE

Executive Director

ACS Introduces New Vision To Mark 130th Anniversary

If you attended the spring meeting of the American Chemical Society in Atlanta or if you are one of more than 100,000 members who received an e-mail from ACS President Ann Nalley, you know that ACS has announced its new vision statement: "Improving people's lives through the transforming power of chemistry." The statement was unveiled just a few weeks in advance of the Society's 130th anniversary of its founding in April 1876.

Many ACS members grew up with the DuPont vision, "Better things for better living through chemistry." I know I did, and it was influential in inspiring me to become a chemist. The ACS vision, "Improving people's lives through the transforming power of chemistry," is intended to have the same inspirational and aspirational qualities for both current members and people whom the Society wishes to attract, as well as a generation of young people. The vision statement recognizes that chemical scientists and engineers—through the transforming power of chemistry—will enable people to lead healthier, safer, more prosperous, and even happier lives, and that ACS will help these chemically oriented professionals in this quest.

To develop this statement, the ACS Board of Directors engaged in a year-long process that sought the opinions and ideas of all of its members. The process began in December 2004, when the Board decided that it would like to have a new vision statement to underpin its strategic plan for 2007–2009. The process concluded in December 2005, when the Board approved the final vision statement.

Beginning in January 2005, ACS staff conducted research for several months. The Board then approved an open-ended questionnaire that attendees to the Washington, DC, national meeting in August were able to fill in at computer kiosks around the registration area and in hotels. More than 2,000 members took time—averaging 20 minutes per questionnaire—to share their views of the Society's future. From these results, another questionnaire was drafted, and all ACS members were invited to provide input. Over 5,000 members responded to this questionnaire. In all, more than 7,000 members contributed their detailed views to the new ACS vision. The Board also invited all members of ACS governance to weigh in on the vision and "vision field," which is a further elaboration of the vision statement. The vision field describes in more detail the ACS members, value proposition, partnerships in the United States and worldwide, image, and reputation (see box on next page).

President Nalley told members in her e-mail that the vision statement and vision field will serve as "guiding propositions for the next 15 years. We want the Vision to be synonymous with chemists and chemistry, to be what we reach for as a Society, a profession, and an individual practitioner."

Nalley also asked for members' help to make the vision a reality: "I have said that volunteers, like you, are what make the ACS a great Society," she wrote. "The Vision embraces that theme and underscores your power to make a difference. Whether it's in communicating about the value of basic research to the well-being of our citizens or transforming the educational system to provide better science training, *you* will make it happen. Those are my themes and I see the new Vision providing inspiration to succeed. … I invite your comments and suggestions on how we can use this Vision and Vision Field to guide and inspire our activities, whether at the national level, as individuals, or in local sections, divisions, or committees. Please write me at president@acs.org."

I urge each of you to take advantage of President Nalley's invitation. And be sure and look for the new vision statement to start appearing on the ACS website, documents, letterhead, publications, and at regional meetings.

And finally, please use the vision statement in your conversations with friends and neighbors. "Improving people's lives through the transforming power of chemistry" is a great way to help non-chemists appreciate the importance of what you do as a chemical scientist or engineer. ⬢

Madeleine Jacobs

Madeleine Jacobs (ACS '96)
Executive Director & CEO

ACS Vision Statement: *Improving people's lives through the transforming power of chemistry*

ACS VISION FIELD:

Our Value Proposition

- We enable the integration of the sciences and enhance the effectiveness and value of scientists, engineers, educators, and others who practice and use chemistry.
- We enable our members to advance their careers and become leaders of the chemistry enterprise.

Our Members/Volunteers

- We are proud to be scientists, engineers, educators, and others who practice and use chemistry.
- We are valued contributors to society.

Our Relationships/Partnerships

- We actively promote the science and the profession.
- We actively partner worldwide with other professional societies and industry to advance the sciences.

Our Image/Reputation

- We are respected for our scientific expertise and professional integrity.
- We increase the public's appreciation of those who practice and use chemistry, and the positive impact chemistry makes in all of our daily lives.

Our Organization/Members

- We are organized to help scientists, engineers, educators, and others advance the science.
- We are organized to build communities of scientists, engineers and educators from many disciplines in order to answer questions, solve problems, create new possibilities.

It's a Sensor, Folks!

GLENN WILLIAMS

NARWHAL'S SENSOR

THE NARWHAL'S BRAGGING POINT is a spiral-shaped tooth 6–8 feet long. It juts from the head of this 3,000-pound arctic whale like a unicorn's horn. Medieval con artists actually sold narwhal teeth as unicorn horns, which were believed to have magical disease-curing powers. Queen Elizabeth I reportedly shelled out 10,000 pounds for a horn that actually was a tooth.

What *are* those teeth for?

Experts have argued that narwhal teeth are icebreakers, weapons, and lures to attract mates.

A study by Martin Nweeia of Harvard University has concluded that the narwhal's tooth actually is a chemical sensor. Working with associates at the National Institute of Standards and Technology and the Smithsonian Institution, Nweeia determined that the tooth has millions of special nerve endings that constantly monitor environmental conditions.

Nweeia concluded that narwhals use the tooth to detect gradients in water chemistry, including salinity, that enable them to find the fish they consume. ⬢

King Coal

SOMETIMES CALLED THE "SAUDI ARABIA OF COAL," the United States has enough proven reserves of coal—more than 250 billion tons—to last 250 years. That energy bonanza is equivalent to all of the Earth's known oil reserves.

Coal produces half the country's electricity. Expanding its role, however, demands revolutionary new ways of burning coal cleanly and converting it into fuels that could power cars.

DOE

ARTIST'S CONCEPTION of FutureGen Facility

The U.S. Department of Energy (DOE) and the FutureGen Industrial Alliance are quietly moving toward that goal. The electric utility companies that make up the alliance will contribute $250 million of the $1 billion cost. Site selection, design, environmental analyses, and other activities in 2006 will lay the groundwork for the coal-fired power plant of the future.

"The prototype plant will be a stepping-stone toward future coal-fired power plants that not only will produce hydrogen and electricity with zero emissions but will operate with some of the most advanced, cutting-edge technologies," said Secretary of Energy Samuel W. Bodman.

The facility, also called FutureGen, will use coal-gasification technologies to convert common air pollutants such as sulfur dioxide and nitrogen oxides into usable byproducts such as fertilizers and soil enhancers. Mercury pollutants also will be removed.

These technologies will yield a highly enriched hydrogen gas that can be burned much more cleanly than coal itself. The hydrogen also could be used in fuel cells to produce ultraclean electricity, piped to refineries to upgrade petroleum products, or used to fuel hydrogen-powered cars and trucks.

The FutureGen facility will be designed to capture CO_2 and sequester it in deep underground geologic formations. The target date for beginning operation is 2012. ⬢

UC BERKELEY

JENNIFER DOUDNA (ACS '98)

RNA to Genes: "Shhh!"

RIBONUCLEIC ACID (RNA) DOES MORE THAN CARRY deoxyribonucleic acid's (DNA's) genetic message out of a cell nucleus into the cytoplasm and use it to make proteins. RNA also can block protein synthesis.

This gene-silencing process, called RNA interference, is critical in brain development, the body's defenses against viruses, and other functions. The genetic "Shhh!" starts when a double-stranded segment of RNA encounters the enzyme Dicer. Aptly named, Dicer "chops" the RNA into pieces that can then attach themselves to genes and block their activity.

Scientists now have the first detailed molecular structure of Dicer, thanks to research headed by biochemist Jennifer Doudna (ACS '98). She holds joint appointments with the Lawrence Berkeley National Laboratory's Physical Biosciences Division and the Department of Molecular and Cell Biology and Department of Chemistry at the University of California–Berkeley. She's also an investigator with the Howard Hughes Medical Institute.

"With this crystal structure, we've learned that Dicer serves as a molecular ruler—with a clamp at one end and a cleaver at the other end, a set distance away—that produces RNA fragments of an ideal size for gene silencing," Doudna explained.

"Knowing the structure of Dicer sets the stage for understanding how Dicer enzymes are involved in other phases of the RNA interference pathway," Doudna added. "In human cells, the evidence points to Dicer being part of a larger molecular complex that directs the RNA interference process. The core structure of Dicer has been highly conserved by evolution and could serve as a guide in redesigning the RNA molecules that direct specific gene-silencing pathways." ⬢

Stardust's Collector

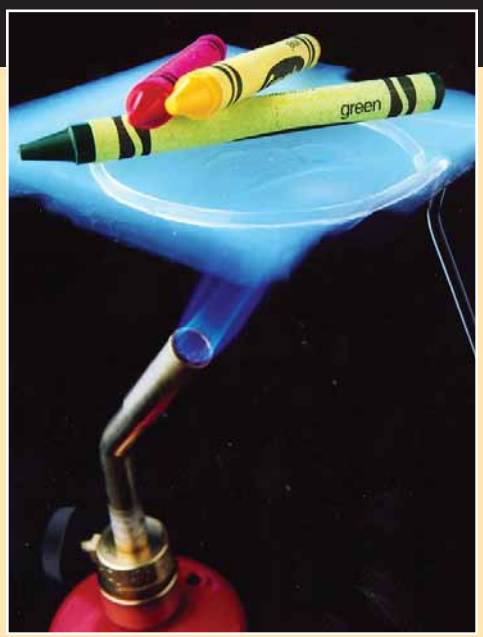
AN ODD MATERIAL CALLED SILICA AEROGEL was the unheralded hero in a National Aeronautics and Space Administration (NASA) mission that brought the first samples of comet dust to Earth. NASA's *Stardust* spacecraft captured the dust in 2004 while flying within 147 miles of Comet Wild 2. It returned its sample capsule to Earth on January 15, 2006.

When flying by the comet, *Stardust* deployed a tennis-racket-shaped collector that snared comet particles in layers of aerogel.

"It's a little bit like collecting BBs by shooting them into Styrofoam," said Scott Sandford, project co-investigator at the NASA Ames Research Center (Moffett Field, CA).

Scientists expected that some of the grains would have exotic isotopic ratios. They also expected that these grains could reveal information about the composition of the giant molecular cloud from which the Solar System is believed to have condensed 4.5 billion years ago.

Comets probably were among the first condensates—that is, solid particles that lumped together to form Earth and other celestial bodies. Gravity, however, yanked about 1 trillion of the leftovers from the Solar System's birth into an orbit far from the Sun. Occasionally, a comet returns to the inner Solar System and can be seen from Earth.



LAWRENCE BERKELEY NATIONAL LABORATORY

AEROGELS are the world's best solid insulators.

NASA chose aerogel as the ideal trap for comet dust. Made from silica (sand), aerogel typically is 50–99.5% air. As such, it is the lightest and lowest-density solid known to exist. It looks like a blue cloud and feels like plastic foam. Aerogel, however, is superstrong and an excellent insulating material.

To avoid the possibility of contaminating the comet dust with terrestrial material, chemists specifically formulated the aerogel sent on the *Stardust* mission to contain 10 times less carbon than aerogels typically used on Earth.

NASA plans to make the *Stardust's* samples of comet dust available to the general scientific community for study. "My guess is people will be asking for and working on these samples for decades to come," Sandford said. ⬢

Maybe It's the Flavanols

SCIENTISTS HAVE DISCOVERED CONVINCING NEW EVIDENCE that flavanols, a group of phytochemicals, play a role in conveying the heart-healthy effects of certain cocoa and chocolate products.

Flavanols exist in many heart-healthy foods, from green tea to red wine. And they may have other benefits—for example, the antibacterial effects of cranberry juice, a time-honored remedy for urinary tract infections.

Researchers from the University of California–Davis, the Heinrich–Heine University of Düsseldorf, and Harvard Medical School have directly linked high consumption of a flavanol called epicatechin to healthy blood flow in the human body.

EPICATECHIN

"Although previous studies strongly indicated that some flavanol-rich foods such as wine, tea, and cocoa can offer cardiovascular health benefits, we have been able to demonstrate a direct relationship between the intake of certain flavanols present in cocoa, their absorption into the circulation, and their effects on cardiovascular function in humans," said Hagen Schroeter, a UC–Davis biochemist and co-leader of the study.

"The results of this study provide direct proof that epicatechin is, at least in part, responsible for the beneficial vascular effects that are observed after the consumption of certain flavanol-rich cocoas," Schroeter added.

Researchers got help from the Kuna Indians, who inhabit islands off the coast of Panama. The Kuna traditionally consume three to four cups of flavanol-rich cocoa daily and have little heart disease. Kuna who move to Panama City, however, drink only three to four cups per week, and their heart health declines.

Schroeter reported other evidence of cocoa's benefits as well. For instance, the island dwellers had twice the urinary levels of nitric oxide (which promotes cardiovascular health by relaxing blood vessels) than their mainland counterparts, and individuals who drank more epicatechin-rich cocoa had higher blood levels of nitric oxide. ⬢

Happy Birthday, Ben!

AS THE 300TH ANNIVERSARY OF BENJAMIN FRANKLIN'S BIRTH, 2006 is a year for celebrating Ben's genius, especially in laying the conceptual foundations of the science of electricity.

Franklin, however, might stake a claim to being the first American surface chemist, suggested James P. Wightman (ACS '56) of Virginia Polytechnic Institute and State University. Modern surface chemists busy themselves with the factors and forces that act at the surface of solids, liquids, and gases—or at the interfaces between two phases.

VIRGINIA TECH

JAMES P. WIGHTMAN (ACS '56) recreating Franklin's surface tension experiment at Virginia Tech's Duck Pond

"People have been studying the effect of surface chemistry as a 'natural science' for longer than you might think," explained Wrightman. "When Benjamin Franklin wrote in his journal about his first observation of the effect of oil on water, he recalled the writings of Pliny the Elder (23–79 A.D.) on the same subject."

Franklin made these observations while traveling by ship in a fleet sailing to Europe in 1757. He noticed that the ships at the rear of the fleet seemed to have smoother sailing than ships at the front. His ship's captain explained that the cooks had probably dumped greasy water into the sea, "which has greased the sides of those ships a little."

Once in London, Franklin dropped a teaspoon of oil into Clapham Common Pond on a windy day and observed that it spread over half an acre, making the surface as smooth as glass.

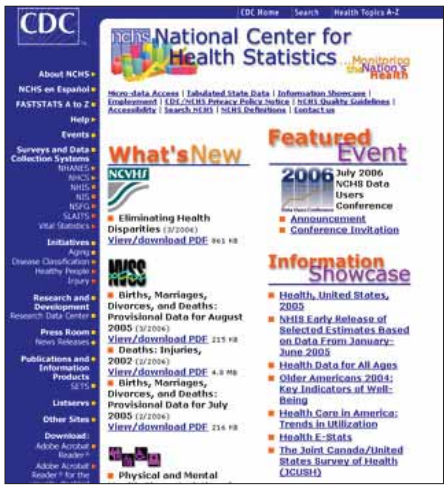
"After this," Franklin wrote in his journal, "I contrived to take with me, whenever I went into the country, a little oil in the upper hollow joint of my bamboo cane, with which I might repeat the experiment and I found it constantly to succeed." ⬢

When Websites Vanish

Internet Archive: The Wayback Machine

www.archive.org/web/web.php

Don't click away in frustration when you get one of those 404 error messages that says, "File Not Found." It may be right there in the Internet's attic. The Wayback Machine lets you rummage through an archive of websites from the past. This site is a "must" place to search when you want to include older information, because it's where to find webpages after they're taken off the web and sites that are no longer active. In fact, the Internal Revenue Service (IRS) Audit Guidelines recommend that an auditor do a Wayback Machine search on the audit year to determine the type and cost of Internet goods sold at that time. The Wayback Machine also includes moving images, texts, audio, software, and various open-source educational resources. The archive dates to 1996—just a few years after the World Wide Web was released by the Centre Européen de Recherche Nucléaire (CERN)—and contains more than 55 billion webpages in its quest to provide "universal access to human knowledge."



Nation's Vital Stats

National Center for Health Statistics

www.cdc.gov/nchs

How healthy are Americans? Our nation's vital statistics are available to search and cite at the U.S. Centers for Disease Control and Prevention (CDC) National Center for Health Statistics website. Check out FASTSTATS for a comprehensive list of links to statistics on conditions ranging from allergies to whooping cough. Births, marriages, divorces, and deaths are among the bonanza of other stats. Here you will find that the average American male lives to age 74.5, whereas American women live, on average, 79.9 years. This general gauge of a nation's overall health has increased by 27 years for men and by 29 years for women from the beginning of the twentieth century through 2002. Monitor the major health risk factors (such as regular physical activity, smoking, consuming more than five drinks in a given day at least once in the past year, and body weight) to see how we as a nation are doing to improve our collective physical and mental health.

Hot Journal Articles and Patents

Heart Cut and Patent Watch

chemistry.org/heartcut.html
chemistry.org/patentwatch.html

What gems are featured on the ACS website for everyone interested in staying up to date on the latest chemistry research articles and patents! Heart Cut offers weekly summaries of the latest and most exciting publications in the chemistry-related journals. The various topics might range from a mechanism to directly convert benzene to phenol using a rhenium catalyst to insights into the molecule responsible for the fragrance of bread. Patent Watch focuses on new drugs and other inventions. It includes a link to the Chemical Abstracts Service that provides basic information about the patent. Take advantage of the cool RSS feed option for this website and an increasing number of others. RSS stands for Really Simple Syndication or Rich Site Summary, a wonderful feature that delivers new items posted on the site straight to your computer, instantly and automatically. Click the orange RSS button to go to a page where you can subscribe to RSS feeds from these and other ACS publications.

Candid Advice on Digital Cameras

DC Views and Digital Photography Review

www.dcviews.com/
www.dpreview.com/

Looking to upgrade your digital camera or go digital for the first time? Start your shopping with candid advice from these two sites. At DC Views, search the exhaustive list of cameras by manufacturer or by general user category (such as snap-and-shoot users, enthusiasts, or professionals). View showcased photos in the Hotshot of the Day and read equipment details to see each camera's capabilities. The Digital Photography Review site features active discussion forums and links to vast photo galleries. A timeline provides digital camera product announcements from 1995 to 2006. Once you have narrowed your search down to several models, read user reviews to help finalize your decision. Digital Photography Review also offers a Buying Guide that lets you enter the specific features you seek in a camera and returns a list of those that fit your specifications. Its side-by-side comparison highlights differences between otherwise similar products.

An Eye on E-Books

Google Books

http://books.google.com/

The "About" page in Google's Book Search page may best describe this site: "In May 1961, JFK said that he was going to put a man on the moon. The idea was unthinkable at the time, but within the decade, the goal was achieved. Google Book Search is our man on the moon initiative. We see a world where all books are online and searchable." Traditional libraries just don't deliver what Google can. Search the full texts of books to find relevant research or other areas of interest before you buy it, borrow it, or download it—in a matter of milliseconds. Google Books does what Google does best: produces reliable search results, with the book information and a Snippet View (a few sentences of your search term in context). If the author or publisher has given permission or if the book is out of copyright, you may also see Sample Pages or even Full Book Views. Sold on a book? Buy it via direct purchasing for paper or digital copies (when available).

Kristin Kili Lay teaches chemistry at the Benjamin Franklin International School in Barcelona, Spain. She often uses the Chem.WWW links to supplement the curriculum for her AP, conceptual chemistry, and other courses.

Quick Hits

Scientists' Take on National Security

www.fas.org

Formed in 1945 by atomic scientists from the Manhattan Project, the Federation of American Scientists (FAS) addresses a broad range of national security issues in a mission to promote humanitarian uses of science and technology. The FAS website opens the door to those modern efforts with a wide range of information on nuclear security, biodefense, U.S. and foreign weapons systems, and related topics. Don't miss the one-page fact sheets that offer an excellent overview of different biological and chemical weapons (go directly to www.fas.org/main/content.jsp?formAction=325&projectId=4 or—from the home page—click Biological and Chemical Weapons under Strategic Security, then choose from the links in the right bar).

The Fool and Money

www.fool.com

The Motley Fool is nobody's fool when it comes to money. This site is where you can find tomorrow's blue-chip investments today. Catchy articles like "Financially Set or Seriously Rich?" help you make the most of a retirement plan or fashion a game plan for your retirement portfolio. The site also offers personal finance assistance, with topics from stocks and investments to credit reports and various how-to guides. Attending an online session at Fool's School can be entertaining, amusing, and enriching.

HTTP TV

www.tv.com

Millions of TV viewers use tv.com as a one-stop site to get more out of the traditional entertainment experience. It offers just about everything about TV: plot summaries, reviews, picture galleries of the stars, entertainment news, and thousands of show listings. Episode downloads are available to make your morning commute a little more enjoyable. Check out Metacritic, which compiles reviews of film, video, books, music, television, and games from respected critics and publications.

Online Comparison Shopping Mall

www.shopzilla.com

A clean and simple user interface, effective graphics, and straightforward product categories give Shopzilla all the tools you need to quickly and easily comparison shop for more than 40 billion products. Search the hottest handbag styles, make Fido happy with a new doggie bed, or outfit your deck with new furniture. When you find products you want to compare, add them to your list, then compare with a click. Direct links to product websites are provided, along with customer reviews of products and stores.

Point, Click, Eat

www.food411.com

Food411.com is the "ultimate food resource for everything on the web related to online food-shopping opportunities." In four clicks you can have Asian Kung Pao Shrimp delivered to your door by Gourmet Grocery Online, which delivers nationwide. Search for culinary tools, hard-to-find ingredients, gourmet gifts, artisan products, or tried-and-true recipes. Food411.com makes it easy to point, click, and eat!

Quick Hits *(continued)*

Do-It-Yourself Digital

http://digitalhome.cnet.com

"See one, do one, teach one" is a time-honored educational credo in surgery—although the "see" and "do" stages actually involve numbers much larger than one. CNET.com's Digital Home DIY is a dream of a website for do-it-yourself home technology projects. Enter the virtual house, and click links to view the projects in that area: deck/patio, home office, or den, for example. The video clips of actual projects can be much more informative than written instructions.

Museums and More Museums

www.coudal.com/moom.php

Browse the Museum of Online Museums' (MoOM's) Museum Campus; Permanent Collection; and Galleries, Exhibitions, and Shows sections to find links to the Musée d'Orsay in Paris, the Rhode Island School of Design, New York City's Museum of Modern Art (MoMA), and the Vincent Van Gogh Gallery (endorsed by the Van Gogh Museum of Amsterdam). Keep browsing, and you'll find links to the obscure and the bizarre, like the Burnt Food Museum and the World's Largest Dice Collection. The vast MoOM archive contains links to both real and virtual museums.

All About Movies

www.imdb.com/

More than just plot summaries and reviews, the Internet Movie Database offers a search feature for local movie times, a list of top box office features, and much more. Check out the GameBase's Hot Game Picks or the DVD/Video section for a list of new releases.

Nano Hits

Kid-Friendly, Librarian-Approved

www.ala.org/gwstemplate.cfm?section=greatwebsites&template=/cfapps/gws/default.cfm

The American Library Association's (ALA's) Great Web Sites for Kids offers an archive of links that are listed by category and can be searched by topic, intended age group, or URL.

Go Ahead, Complain!

www.complaints.com

Complaints.com is a site for publicizing and reading complaints about poor-quality consumer products. Share your experiences, help others avoid the same traps, or just vent.

Science on Screen

www.movingimage.us/science

At the Museum of the Moving Image's Sloan Science Cinémathèque, enjoy online fare like a recently premiered exhibit that explores the more complex portrayals of research and researchers in popular culture.

Physical Reference Data

www.physics.nist.gov/PhysRefData/Elements/cover.html

The Elemental Data Index contains atomic spectroscopic, X-ray, γ-ray , radiation dosimetry, nuclear physics, and condensed matter data for each element.

Online Frivolities

www.littlefluffy.com/

Call it a productivity-depletion website. Little Fluffy Industries is a place to waste time with games, amusements, distractions, diversions, delectations, and frivolities.

Goods for Geeks

www.thinkgeek.com/

Think Geek offers a knife with fire-starting abilities, USB storage with fingerprint recognition, and 1,337 letter tiles that will allow you to hack Scrabble. Think geek, geek, geek.

BY CYNTHIA WASHAM

PLUGGING A LEAKY Pipeline

Colleges and organizations like the ACS are trying to keep African American and Hispanic chemistry students in the career pipeline that leads to a Ph.D.

MIKE SUMMERS

Mike Summers can only dream of the day when he treats black students the same as white. "To say I need to treat everybody the same is to say I'm happy with the status quo," said Summers, who is with the Department of Chemistry and Biochemistry and the Howard Hughes Medical Institute at the University of Maryland Baltimore County (UMBC). The status quo is that an ethnic group comprising 12% of the U.S. population accounts for only 3.6% of chemistry Ph.D.s. The rate of Ph.D. chemists among Hispanic-Americans is even lower.

With that disparity in mind, Summers is working to ensure that the brightest minority students with a passion for chemistry fulfill their dreams. He recruits the nation's best, then gives them the support they need to succeed in a university where the students are predominantly white.

Other universities, such as California State University–Los Angeles, with its largely Hispanic student body, also are striving to produce more minority chemists. Chemical manufacturers are doing their share by offering scholarships and internships to minority students. "We've been focused on this since the '70s," said Ron Webb (ACS '98), manager of doctoral recruiting for Procter & Gamble. "Growth in minority chemists has been modest in the last 10–20 years in spite of our efforts."

ACS Plugging the Pipeline

Meanwhile, ACS and other professional organizations also have been working on the problem. One effort launched jointly by the ACS Committee on Corporation Associates and Committee on Minority Affairs, for instance, tried to address barriers and suggest ideas to "plug the pipeline." Webb explained that African Americans and Hispanics enter undergraduate chemistry programs at a much higher rate than they enter Ph.D. programs. "Somewhere between freshman chemistry and graduate school, there is a leak in the pipeline."

This effort has brought together leaders in the recruitment and education of minority chemists to share ideas and solutions with a group of invited attendees. "The group we need to reach with this information is the department chairs in chemistry in the research universities," said Webb. "Hopefully, we can convince them to provide undergraduate professors with advice on how to encourage more minorities to enroll in Ph.D. programs."

Social Deterrents

RUKEYSER THOMPSON (ACS '01)

One way Procter & Gamble stays on top of the consumer market is by employing a diverse research and development (R&D) team. Webb has managed to hire a group of Ph.D. chemists that are 15–20% minorities, even though minorities make up only 7% of all Ph.D. chemists. "We have to have scientists who look like America does," explained Rukeyser Thompson (ACS '01), a black Ph.D. chemist at Procter & Gamble. "Products white people use for their hair are not going to work for me, and products I use for my hair are not going to work for white people."

Ask why so few minorities go into chemistry, and you'll get several different answers. Yet most people agree that the disparity has less to do with race than social class. The problem starts in grade school and worsens in high school because children from blighted neighborhoods tend to go to schools that lack the resources that schools in affluent areas have. Many of those shortchanged students are Hispanic or African American. "I see great differences in the preparation of students," said Carlos Gutierrez (ACS '75), a chemistry professor who recruits mostly Hispanic students at Cal State–Los Angeles. "We're not investing enough in education."

Black freshmen who find themselves surrounded by white students who are better prepared can quickly lose motivation. Professors sometimes discourage minority students who are poorly prepared by assuming that they just don't have what it takes. "If you've been teaching chemistry for 20 years and have had only two or three blacks in your class," Summers said, "you have expectations based on that history."

Models of Success

ISIAH WARNER (ACS '74)

Universities that excel in recruiting and retaining minority chemistry students go beyond offering equal opportunity. "It takes a welcoming environment," said chemistry professor Isiah Warner of Louisiana State University (LSU). "We teach [underperforming freshmen] study skills. We teach them time management. We teach them that they're responsible for their education."

These simple, often overlooked efforts have made Warner a legend among minority chemists. His mentoring program has earned him many awards, including one from the ACS. The number of minority students in LSU's doctoral chemistry program climbed from two in 1992 (the year Warner was hired) to 30 in 2006—more than any other university in the country.

Another model of success in minority chemistry education is UMBC. Like LSU, UMBC has a prominent black role model, President Freeman Hrabowski III. The hallmark of the university's science program is the Meyerhoff Scholarship Program, which has supported about 50 new students (mostly minorities) every year since 1989. Meyerhoff Scholars attend summer classes before their freshman year, meet monthly throughout their undergraduate years, and complete an internship at an outside lab.

"It becomes a family-like environment," said Summers, who works with the Meyerhoff undergraduates and oversees the Meyerhoff program for graduate students.

A Strong Support System

For too many minority chemistry majors, education ends with a bachelor's degree. Graduates with student loans to repay may feel that they have to jump right into the job market. Many chemistry majors who do decide to continue studying choose medical school because they know a respected minority physician. Minority Ph.D. chemists are so scarce that many chemistry majors go through college without ever meeting one.

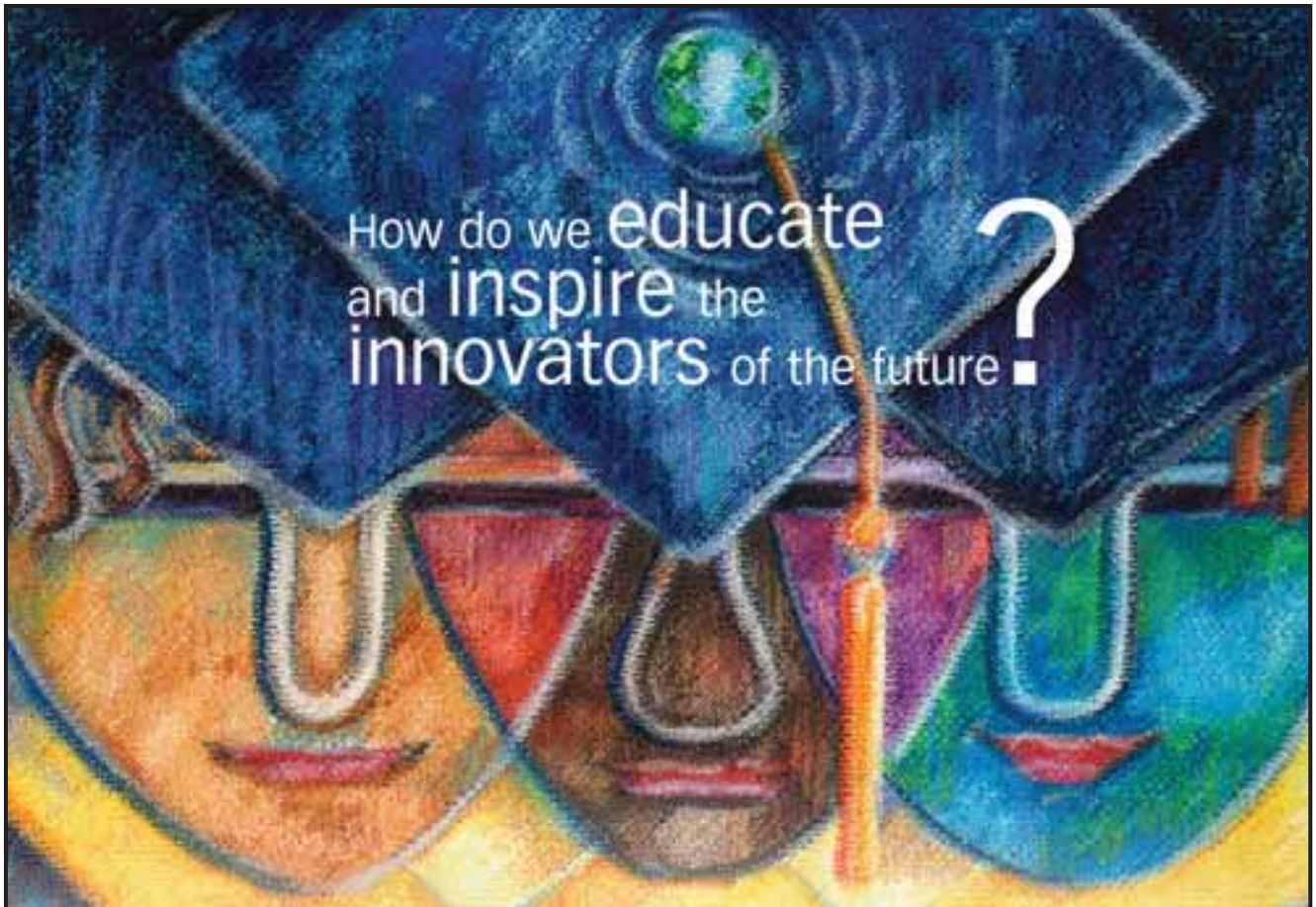
"It's very important to see people who look like you doing things you want to do," Thompson said. She saw plenty of African American chemistry professors during her undergraduate years at Alcorn State University, a small, historically black university in Mississippi.

Figures from historically black colleges and universities (HBCUs) underscore the importance of minority professors in spurring graduates to seek advanced degrees. Nine of the 10 colleges that graduate the most African American students who go on to earn Ph.D.s are HBCUs, even through more black students attend universities where the majority of the students are white.

By giving minority science students a strong support system and providing African American role models, UMBC and other white-majority schools match the success of HBCUs. Eighty-five percent of UMBC's Meyerhoff Scholars attend graduate school. And if they listen to Summers, they go just about anywhere but UMBC. "We really need high-achieving minority students going to other universities and influencing expectations there the way they have here," he explains.

When enough of them do, the percentage of minority Ph.D. chemists might eventually grow to equal that of the minority population. Then, Summers will realize his dream and treat the education of black students the same as that of whites. ⬢

Cynthia Washam has written for publications ranging from the Los Angeles Times *to* Environmental Health Perspectives. Chemistry's *regular CareerView columnist, Washam works from Jensen Beach, FL, where she lives with her husband and son.*



Your support of ACS programs can help us meet this challenge.

Our next generation — Project SEED and ACS Scholars

American Chemical Society programs designed to spark the interest and support the academic achievement of aspiring, young chemists

Project SEED

A summer educational experience targeting economically disadvantaged high school students who are interested in science. It provides the rare chance to work alongside scientist-mentors on research projects in industrial, academic and federal research laboratories.

ACS Scholars

College scholarships for talented students with financial need. The program provides support and mentoring to African American, Hispanic and Native American undergraduates majoring in the chemical sciences.

For more information on these programs or to make a gift, please contact Mary Bet Dobson or Kathy Fleming, ACS Development Office, 1155 Sixteenth Street, NW, Washington, DC 20036 1-800-227-5558, ext. 6210 or visit www.chemistry.org/gifts

You can help us meet the challenge.

Fostering Undergraduate Research

ACS Student Affiliates chapters on college campuses around the country play an important role in getting undergraduates interested in laboratory research.

RHETT BARKER

CHARLES M. BALDWIN (ACS '71)

Rhett Barker's chemistry research is the type that any college student can appreciate: He and fellow Student Affiliates at Union University are testing Starbucks coffee to determine which roast packs the most caffeine.

The Great Coffee Experiment at the Jackson, TN, school "provides an excitement, a point of interest that makes the study of chemistry relevant," said Charles Baldwin (ACS '71), adviser of the SA chapter. "There's a lot more interest in the questions that chemistry can answer as a result of students carrying out research projects, particularly research projects of this sort. We tend to think of coffee as social, but there's a lot of chemistry there."

Student Affiliates chapters provide critical support for undergraduate research, which not only enlivens the study of chemistry but also helps students at four-year universities and community colleges develop skills they will need in the workplace.

"All the research has shown that when undergraduates are really involved, and when they are involved in research particularly, they gain such self-respect and get into the mode of working with others and independently," said Etta Gravely (ACS '81), chair of the ACS Task Force on Undergraduate Programming for 2006. Gravely, who is also co-adviser of the SA chapter at North Carolina A&T State University, said research is one way of involving undergraduates in an activity that allows them to observe results directly and that teaches skills such as discipline and the ability to work collaboratively.

Fostering Undergraduate Research

The ACS Student Affiliates program supports undergraduate research in many different ways. Student Affiliates present research poster sessions at ACS national meetings, giving undergraduates a chance to interact with chemistry professionals and receive feedback on their research. The spring meeting usually draws more than 900 poster presentations, and the Union University project was among those scheduled for presentation at the March 2006 meeting in Atlanta, GA.

At the regional level, ACS provides grants to SA chapters to plan and host undergraduate programming at regional meetings. The programming almost always includes a session for undergraduate research presentations. At the local level, chapters get involved in undergraduate research in lots of ways: coordinating investigations such as the Starbucks experiment, sponsoring poster sessions and oral presentations, hosting research nights at which faculty members can present projects they'd like students to pursue, and fund-raising to send Student Affiliates to regional and national meetings.

Starbucks Research

Barker, a junior and president of his SA chapter, says the Starbucks research project has taught him how a group can come together to accomplish a goal. The manager at their local Starbucks has enthusiastically supported their research, donating a French press and offering an hour-long tutorial on how to make coffee the Starbucks way.

Some of the early test results surprised Barker. He had expected bold blends, which are roasted longer, to have less caffeine. But preliminary research debunked that expectation. "The most interesting thing chemically is that the caffeine content doesn't depend on the type of roast," he said. The early caffeine winner: Guatemala Antigua.

Like any good scientist, Barker already was planning the next phase of his experiment. "We're hoping to spread out and even go into the flavoring agents of coffee besides caffeine."

Rachel Smolkin writes on education and other topics for newspapers, magazines, and other publications. Chemistry's *regular SA columnist, Rachel also contributes articles on other topics from her home base in Washington, DC.*

TRAVEL SITE OR TRAVEL AGENT?

BY ROBIN SUSSINGHAM

The old-fashioned travel agent may seem like a relic of the pre-WWW past. But travel agents still have a lot to offer for certain kinds of travel and travelers.

For many travelers who use computers, booking airline tickets online has become almost second nature. Head for your favorite travel website—Travelocity or Expedia, for instance—or the airline where you're piling up those frequent flier miles. Keyboard the three Ds: departure location, destination, and dates. A mouse click finds the flights. Scroll through the list. Select your choices. Buy the tickets. Done.

You also can purchase vacation packages and cruises, reserve rental cars and hotel rooms, and buy museum and theatre tickets online. So when the Internet makes it possible to be your own travel agent, is there any reason to consult a flesh-and-blood travel agent?

The answers are "not really" and "absolutely"—depending on your itinerary and your personality. "The conventional wisdom is, if it's a point-to-point ticket and it's price-sensitive, then book it online. If it's complex, you're better off going through a bricks-and-mortar travel agency," said Christopher Elliott, ombudsman for *National Geographic Traveler.*


CARMEN GAUTHIER (ACS '87)

Carmen Gauthier (ACS '87), a chemistry professor at Florida Southern College in Lakeland, practices the online/offline juggling act to plan her travels. Gauthier doesn't hesitate to book her own tickets to attend ACS national meetings. She chose Internet over a traditional travel agent to buy plane tickets for a lecture trip to the University of North Carolina–Wilmington, for the international meeting of undergraduate chemistry educators at Indiana University, and for a meeting with a collaborator at Brown University. A native of Peru, Gauthier even bought tickets to her home country online for a mother–daughter excursion last June.

Because Gauthier is familiar with the flights to Peru, she felt confident making the arrangements herself for that international trip. But she also knows when to say when. "I've been to Cuba twice," she said. "I would definitely use a travel agency when traveling to Cuba. You can't go online and type in Miami to Havana—there aren't any

Favorite Online Travel Sites

www.kayak.com—Check this metasearch engine, which searches more than 100 travel sites at once.

www.cheaptickets.com—This user-friendly site sorts findings by lowest price, departure time, or shortest flight.

www.farechase.com—Yahoo! offers this metasearch engine.

www.travelocity.com—Don't miss this online giant, which has interesting travel ideas and features plus an easy-to-comprehend format.

www.orbitz.com—Sophisticated computational algorithms and official airfare pricing software give Orbitz its bragging rights.

www.priceline.com—Name your own price "for incredible travel savings" or choose exact flights and times.

www.quickbook.com—Great prices are promised for hotel reservations.

www.hotels.com—This site offers hotel bookings plus airline tickets and other travel services.

MIKE GREENWALD

flights." Similarly, she let a travel agent take care of her arrangements when she spoke to the Latin American Congress of Chemistry in Salvador, Brazil. The agent handled her flight, hotel, and transportation from the airport and even provided advice on the visa requirements. "If it's a country I don't know much about, I use a travel agency," she said.

Gauthier has the right idea, according to experts like travel agent Mike Greenwald, who owns the agency Personalized Travel in Oakland Park, FL. Greenwald charges $41 to book a domestic airplane ticket and $61 for international. Individuals who want an inexpensive ticket from Point A to Point B gain nothing from paying such fees. "If you are buying on price and that is your only criterion, you should go online and get the rock-bottom price," he said. "If all I need is transportation, a Hyundai will get me there as easily as a Cadillac."

Finding Cheap Tickets Online

The major-league online travel sites are Orbitz.com, Travelocity.com, Expedia.com, Cheaptickets.com, and Priceline.com. Each company has different relationships with different airlines, so the bargains may vary from site to site, said Charles Leocha, MSNBC's travel expert and a columnist for Tripso.com. Such variability means that the savvy consumer should check in with at least three websites (please see sidebar) to compare ticket prices. That's a rule, he added. Even if you're going to use a travel agent, do your homework first and check three sites.

You might also try bookingbuddy.com. This handy website consolidates your search by lining up all the online travel sites in one place, and you type in the departure and destination information only once. "It makes life much easier," said Leocha.

A recent addition to the online travel sites are the metasearch engines for travel. These search engines go to the airlines' websites and other travel sites (more than 100 in some cases) and bring back the best prices for you to compare. Some examples are Kayak.com, Sidestep.com, Farechase.com, and Mobissimo.com. These sites will often find prices from low-cost airlines like JetBlue, which don't show up on the bigger travel sites like Expedia.com, Travelocity.com, and Orbitz.com. Again, the metasearch sites have their own features and commercial partnerships that affect your search results.

Of course, some of what you're saving in dollars may be spent in your time on the computer searching and comparing. It's important to know when to stop. "If you find a good price that you can deal with, buy it," said Leocha. "You may find a better price somewhere, but you'll drive yourself crazy."

Remember that a travel site may have only a limited number of seats available at the bargain price. Delay to hunt elsewhere, and someone else may snap up the only available tickets.

Human Versus Computer

"There are some things a machine just can't do," said Elliott. "Agents specialize in things that machines have difficulty replicating: expertise, special training, and special packages that only they have access to."

Greenwald gave an example of one of these insider deals: He once snagged an upgrade to a first-class ticket with a major European airline for a one-way business-class ticket he'd booked. From Washington, DC, to London, a business-class ticket costs $7,500, whereas a first-class ticket costs $10,000—so the upgrade was worth $2,500. "They ain't giving that to someone coming in over the Internet," he said.

Much of Greenwald's business is international and more complicated than a simple

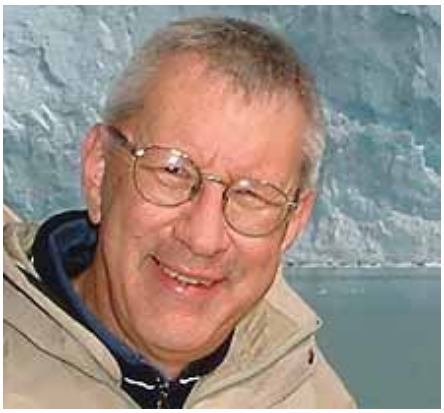
CHRISTOPHER ELLIOTT

point-to-point trip. Even Gauthier, after arranging her flight to Peru online, contacted a travel agent to help her put together a whitewater rafting trip and a chartered flight over the Peruvian desert.

Elliott agreed that even with the technological strides that online travel sites are making, a complex itinerary—a safari, a cruise, or a round-the-world trip—is still best left to a human being. Moreover, if you've done much traveling at all, you know that problems happen. Reservations go missing. Flights get cancelled. And if you've made all the arrangements online, who can you turn to?

Greenwald argues that you'll have better luck with a travel agent. "People call and say, 'I have a problem. I booked a hotel online, got a confirmation, and when I got there they never heard of me. What should I do?' I say, 'You go have a very long talk with your computer. And next time, book through me.' Honestly, some people think I'm being a smart aleck. But if I didn't do the booking, I don't have any standing on that transaction."

There's a another side to that argument, though: Go ahead, try to reach a travel agent for help at 7 PM on a weekend night. Major online travel sites, on the other hand, do have customer service personnel available when real-world travel agencies are closed for the day. Also, most airlines automatically rebook passengers when a flight is canceled. Major hotels rarely lose reservation records, and travelers who book online should carry a printed copy of the reservation as backup.



CHARLES LEOCHA

A Hand To Hold?

Personality is another important factor in deciding whether to plan that trip with a computer or a travel agent. Greenwald argued that travel agents offer customers an extra level of security. "By taking a fee," he said, "I am holding myself liable." And when things go south, customers have a sympathetic ear or, as Leocha puts it, a hand to hold.

That security can be important, even to some scientists and other frequent travelers—especially on trips to new venues off the beaten path. Others, however, become quite independent as they pile up the miles and would rather wrap their hand around that cash not paid in travel agents' fees.

Human travel agents will always offer one big advantage: They can really get to know you. Online travel sites do allow customers to create a profile that includes favorite airline seating, hotel room types, and other preferences. If you can manage to build a relationship with a good agent, you'll have someone who knows your tastes and preferences and who will let you know when a good deal arises. ⬢

Robin Sussingham writes on science, medicine, and other topics from Lakeland, FL. As a frequent traveler who often books online, Robin learned a lot about the continuing role of travel agents while researching this article for Chemistry.

Tips

- Sign up at online travel, airline, and hotel sites to receive e-mail alerts about bargains.
- If you're traveling on short notice or have the flexibility to do so, look for last-minute bargain pages at travel sites.
- Check the auto rental, hotel, and other discounts that are a benefit of ACS membership and the adventure travel opportunities that ACS offers through Betchart Expeditions (chemistry.org/ACSBetchart travel).
- Get advice on finding a good travel agent by keyboarding the following phrase into your favorite search engine: "Picking a travel agent."

—RS

ACCUMULATING

Wealth for Retirement and Heirs

BY KERRY J. SCAFELLA

Baby Boomers will live longer and more active lives than any other generation of retired people. These simple pointers can help ensure that you accumulate enough wealth to sustain your lifestyle, enjoy those years, and pass that wealth on to the next generation.

The first of 76 million Americans in the Baby Boom generation are turning 60 in 2006. Just as they've revolutionized American culture, Baby Boomers will reinvent retirement. They are expected to live longer, play harder, and—most telling of all—many are also planning to work in some way in their later years. Not surprisingly, many are also worried about outliving their savings. Aside from serious illness, nothing stands to dampen enjoyment of retirement more than serious financial shortfalls.

People naturally dwell on two key questions as retirement nears: "Do I have enough income to allow me to continue to live my current lifestyle?" and "How do I successfully transfer my assets to my children and heirs?" This column addresses both of those questions and offers a simple checklist to follow when planning for both retirement income and wealth transfer.

Position Yourself Smartly for Retirement

Care about Health-Care Costs

We're going to live longer—but we're also going to require more in the way of health care. In your 50s, if not before, start thinking about long-term-care insurance, which pays for nursing home and in-home care. Also, factor the cost of regular health insurance into your retirement budget.

One thing is for sure—it's not cheap. Health insurance premiums for a married

couple can easily run upwards of $15,000 a year, according to Hewitt Associates' 2005 survey of national health costs.

And remember that when you retire from your job, the insurance policy you walk away with, called COBRA, usually will expire after 18 months unless you convert the policy. The bottom line: Do your homework to see what works best for you.

Test-Drive Retirement Budgets

Be as trim as you can by paying off your debt and investing in capital expenses, such as energy efficiencies, which will reduce bills down the road. And test-drive your retirement plan. Figure out what kind of lifestyle you want and how much it will cost—then live on that budget for a while.

Most of your day-to-day expenses probably won't differ that much. As for big-ticket items like travel or that yacht you've always wanted, be brutally honest about just how much you can afford. Also, be sure to build an emergency cushion into the spending plan you construct.

Real Estate Options

Do you want to live in New Jersey or move to North Carolina? This isn't a trick question. Real estate taxes can take a big chunk out of a fixed income. Think hard about where you want to retire and the economic benefits that different regions bring to the equation in terms of real estate taxes and everything else that will add up to your cost of living.

Also, if you're still working and own your home, now is the time to get a loan to finance the second home you may be thinking about buying.

Consolidate Accounts

A lot of people leave their 401(k) accounts behind when they job-hop. Before you retire, it's a good idea to consolidate your retirement accounts. With everything in one place, you'll recognize whether you're overweighted in a particular sector. Perhaps you'll want to start rebalancing into some fixed-income investments.

At this point, if you haven't developed a relationship with a financial adviser, it would be wise to do so.

Tapping Your Accounts

If you withdraw money from your 401(k) or Individual Retirement Account before you're 59½, you're going to pay regular income taxes on it, plus a 10% penalty tax. After that age, you can take as much money out as you wish, though you'll still pay income taxes.

The glory of the retirement account is that your nest egg is growing at a tax-deferred rate. If you have to tap into any account, target your taxable accounts before you hit the tax-deferred ones.

Also, be sure your beneficiary forms are up to date on your retirement accounts; the beneficiaries you have named will take precedence over anything your will states.

Update and Recalculate

Make sure you have a durable power of attorney, a living will, and a will. It's also important to maintain an updated list of policy numbers and current contact information.

Some financial firms offer something called a "document locator," a form that lists a client's accounts and locations. Be sure to add passwords to the form so that your designated beneficiary or trusted advisers can access information on your computer or other electronic devices. A copy of such information should be kept with a lawyer, a trusted relative, or in a lockbox.

Keep the Plan Flexible

Everything in retirement begins with a plan. But plans are fluid and circumstances change. You'll likely have to change the plan you start out with.

Recalculate on a regular basis. Are you in line with your projections? What life events or circumstances have transpired that might have affected your thinking on retirement? And, remember, too, that it isn't only about the money. Are you living the lifestyle you want?

Planning for Future Generations

An important idea gets easily lost amidst all the talk about the future of the estate tax: Intergenerational financial planning is about more than taxes. To be sure, preserving wealth for your family is a worthy goal. But creating a comprehensive plan can help you achieve even more: You can efficiently transfer both your assets and your values to future generations, and thus help prepare your loved ones to lead more fulfilling lives.

For now at least, the estate tax remains an important, though unpredictable, planning consideration. Today, you can leave up to $1.5 million, tax-free, to your heirs. This estate-tax exemption is scheduled to increase to $2 million in 2006 and then to $3.5 million in 2009.

Unless Congress repeals the federal estate tax altogether—the House has approved a permanent repeal, but no one knows for certain whether legislation will pass the Senate—the tax will disappear altogether in 2010, only to reappear the following year at the previous exclusion amount of $1 million.

One way to plan for the uncertainty is to consider moving assets out of your estate by maximizing your gifting strategy: You can make unlimited, tax-free bequests to a spouse and to charities, along with tax-free gifts of up to $11,000 per individual to your children and grandchildren (or trusts established for their benefit). But before you make any gifting decisions, it's important to clarify your goals and values, which can guide your broader, intergenerational financial plan.

Create a Family Mission Statement

Begin with taking a look at what's most important to you when planning transfers. You may find scheduling a weekend retreat to discuss these ideas to be beneficial. Although there's no "right" answer that comes out of these discussions, many people focus on familial relationships, spiritual beliefs, charitable intentions, and the desire to impart a work ethic to their beneficiaries.

A "family mission statement" may be derived from these deliberations. This statement can be written out, signed by the family members who share these values, and updated every few years.

Draft Legal Estate Planning Documents

It's important to have legal documents in place that are coordinated with your family mission statement. About half of all Americans die without a will, according to the U.S. General Services Administration. Without a will to indicate your wishes, a court distributes your property according to the laws of your state—and chances are, the laws don't conform precisely to the wealth-transfer strategy you have in mind.

Wills aren't the only crucial estate planning instruments that individuals tend to ignore. You should meet with an experienced estate planning attorney to discuss your specific needs for documents that might include: trusts, powers of attorney, and directives for medical treatment.

Think about Using Trusts

To some people, the term "trust fund baby" conjures up images of spoiled children. But in reality, a trust may help you instill your values in your children and grandchildren—and *prevent* them from making undesirable choices.

A trust is an entity created for the purpose of holding certain assets. Because of its flexibility, a well-designed trust can offer many ways to determine how your assets will be used. Distributions to beneficiaries can be set at modest amounts or left to the discretion of the trustee managing the assets. On the other hand, if you make outright bequests, your descendants might go through their inheritances quickly, squandering their money or investing foolishly.

So-called "incentive trusts" have become popular in recent years. They offer rewards to beneficiaries who accomplish certain goals, and financial incentives can be specified for anything you deem important. Beneficiaries might receive particular amounts for completing higher education degrees, running a family business well, attaining preset levels of earned income, or serving in the community.

Select a Trustee

One trust fund approach is to leave distributions to the discretion of the trustee. The trust might indicate what types of activities will be rewarded, allowing the trustee to make distributions as appropriate. For success with this type of arrangement, it is especially important to choose a highly qualified trustee.

Whether it's a relative, a friend or a professional adviser, any trustee you designate should be able to empathize with your beneficiaries, yet make prudent decisions about trust fund distributions. Moreover, you should include a plan for trustee succession, in case your choice becomes unable or unwilling to serve. For long-term trusts, a qualified institution may provide continuity.

There is no precise formula for creating an intergenerational financial plan. But regardless of your goals for your loved ones and the future, taking the time to think through your goals and values is always the best place to start. ⬢

Kerry J. Scafella is a financial adviser with Smith Barney in Washington, DC, who dusted off a journalism degree to become Chemistry's *Personal Finance columnist.*

Chemistry on Television

BY BECKY HAM

CSI's often-unrealistic portrait of forensic science gets a lot of attention. TV, however, sometimes blurs reality in portraying other scientists. Efforts are afoot to refocus those images, which influence public perception of scientists and their work.

In the middle of a blazing-hot Tucson summer afternoon, a group of high school students gathers in a basement classroom on a nearly abandoned university campus. Most of their friends are bantering about girls, boys, movies, and other teen topics while cooling off at the water park or hanging out at the mall. These kids are talking about DNA fragment analysis, toxicology tests, ballistics, and even whether real-life crime scene investigators would wear tight leather slacks on the job like the popular television image suggests.

The slacks aren't very realistic, the students decide. But hey, it's TV—and the clothing is about as believable as anything else seen on prime time entertainment.

After a week in forensic science boot camp, the high schoolers have learned to be skeptics about everything they see on the top-rated television drama *CSI: Crime Scene Investigation.* The camp, sponsored by the Arizona Research Laboratories, showed the students how to process evidence, analyze DNA, and even testify as expert witnesses in a mock trial. But the larger lesson learned, say the students, is that science in the real world is much more complicated than the neat and complete cases shown on *CSI.*

Many other folks have not yet tuned in to that reality (please see sidebar on 34).

The Tucson camp is only one indicator of what researchers are calling the *CSI* "phenomenon," an astonishing wave of public interest that has doubled enrollment in forensic science programs at several universities and made "mass spectrometer" part of water cooler talk. Researchers characterize CSI as the "foot in the door" that could encourage more students to choose science as a career and raise the public's perception of scientists. Eliene Augenbraun (ACS '94), president of the science news production company ScienCentral, described commercial television as a "weapon of mass attraction" for scientists trying to capture the public's eyes and ears.

STACEY FORSYTH/BIO5 INSTITUTE

HIGH SCHOOL STUDENT LISETT HUICOCHEA lifts prints at a mock crime scene as part of the DNA Detectives summer forensics program sponsored by Arizona Research Laboratories.

TV the Teacher

Television has a considerable potential to educate and to influence people's perceptions of science. A 2004 National Science Foundation survey found that almost half of the adults in the United States and Europe learn about science from watching television. Studies show that television programs with a science angle can encourage viewers to seek more information from other sources. The number of visitors to the California Geological Survey's website doubled during the NBC "killer earthquake" miniseries *10.5.* In 2001, the HIV/AIDS hotline at the U. S. Centers for Disease Control and Prevention (CDC) was overwhelmed after an episode of the CBS soap opera *The Bold and the Beautiful* in which a main character learned he was HIV positive.

However, television may also encourage a warped view of how science (or the average scientist) really works. Those unrealistic expectations about forensic science, courtesy of *CSI,* are only one symptom. Much of the world's cutting-edge research is taking place in molecular biology, nanotechnology, and materials science labs. Those disciplines rarely make it on air when the competition is graphic murders and mysterious mummies.

The TV faces of scientists may not fare much better. In one admittedly informal survey in the United Kingdom, the hapless Muppets Dr. Bunsen Honeydew and his assistant Beaker topped the list of favorite television scientists. Despite the increasing diversity of the real scientific workforce, many researchers on the U.K. airwaves still fall into the stereotype that University of Sussex chemistry professor Penny Chaloner (ACS '79) called "short-sighted, hairy, badly dressed, and slightly mad."

FOOD NETWORK

HOST ALTON BROWN discusses research along with recipes on his Food Network show.

Hidden Science on TV

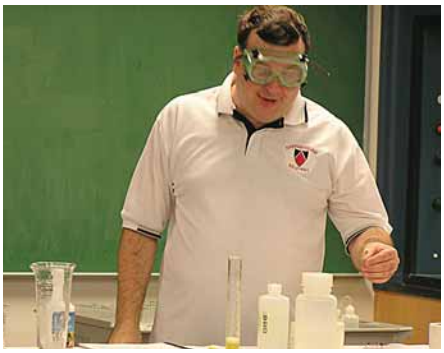
Twenty years ago, science on television meant two options: documentary programming like the long-running *NOVA* series on public television, or vaguely scientific-sounding jargon on science fiction programs such as *Star Trek.* Today, science has expanded its TV presence in ways big and small. Science on television is most noticeable in the expansion of medical dramas and sitcoms such as *ER, House,* and *Scrubs;* the rise of documentary cable networks such as the Discovery Channel and its numerous spin-offs; and specialty channels such as The Weather Channel.

And then there's the "hidden" science, or the programs where science and scientists are not main characters but make more than a cameo appearance. One example is the Food Network's *Good Eats* show, hosted by Alton Brown. It delves into the mysteries of the Maillard reaction (responsible for the golden brown colors and mouth-watering aromas that develop when food is heated) and features food scientists explaining how cheese melts. The White House drama *The West Wing* has its protagonists regularly debating the merits of nuclear reactors and stem cell research.

In one episode of *The Simpsons,* Bart Simpson discovers a comet hurling toward

THE DISCOVERY CHANNEL

***MYTHBUSTERS* is a top-rated show on The Discovery Channel.**



JAMES GOLL

JAMES GOLL (ACS '83) participating in demonstrations for National Chemistry Week 2003 at Edgewood Campus School

Springfield, in a parody of recent efforts by astronomers to measure the trajectory of near-earth asteroids. On the popular Discovery Channel program *MythBusters,* two special effects experts rarely leave anything unexploded in their bid to use science to debunk urban myths such as whether cell phones can ignite gas station pumps.

Commercialized Science

An undercurrent of science—sometimes bad science—also runs through many television commercials, according to Robert Warburton (ACS '84), a biochemistry professor at Shepherd University, Shepherdstown, WV, who teaches a class on chemistry in society. "The first thing we do in lab section is have the students do a little TV watching, watching ads. It forces them to look at all the products that involve chemistry," he said.

"I saw a recent commercial that incorrectly states that hydrofluoric acid is the strongest known acid, and then leads into the ad for the product, noted James Goll (ACS '83), a professor of chemistry at Edgewood College, Madison, WI, who also lectures on the role of chemistry in television and movies. The overall impact was that chemistry is dull and boring, Goll said.

A growing quantity of outlets for science on television hasn't necessarily translated into greater quality, some observers warn. In 2002, veteran science journalist Jon Palfreman noted that the rise of the Discovery Channel and The Learning Channel has forced documentary producers to create new shows from "a limited set of bankable topics that would bring in viewers"—topics such as dinosaurs, disasters, and high-tech gadgetry. In their quest to fill the airwaves, the new channels have also resorted to questionable genres such as alien abductions and paranormal events, Palfreman said.

"I realize they are faced with the problem of needing to fill 24 hours a day, 7 days a week," said Jere Lipps, a paleontologist at the University of California, Berkeley, and long-time critic of science's portrayal in the mass media. "But they would do much better for public understanding of science if they just went off the air at times rather than fill the airways with junk."

JERE LIPPS

JERE LIPPS leads an outreach field trip for teachers and the general public to examine the geologic history of San Francisco and the Golden Gate Bridge.

The Unwatchable Process of Science

At a 2004 workshop for scientists hoping to branch out into screenwriting, television director Alex Singer delivered the bad news to those with scripts bursting with realistic research scenes. "Most scientific work is unfilmable," he said, according to Jonathan Knight's account in *Nature.*

It's true that endless hours in the lab, repetitive experiments, statistical analyses, and grant writing are not exactly cinematic, researchers acknowledge, but what's on screen instead may be giving people the wrong impression about how science is actually done.

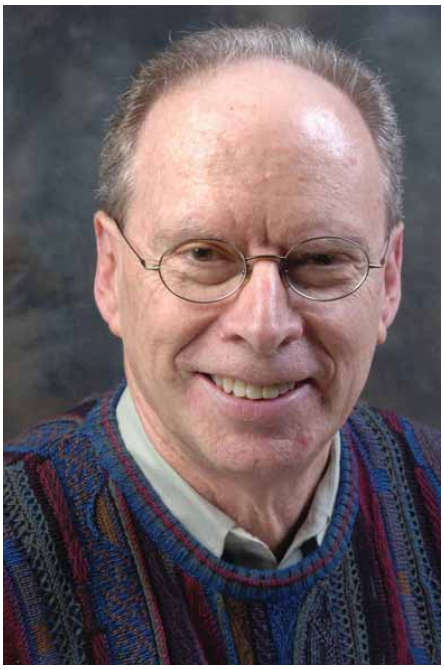
"The most common misrepresentations are that science can give you a quick, definite answer. Many people really do not feel comfortable with the concept that ideas change as more evidence is accumulated," Goll said.

Warburton agreed, saying that shows such as *CSI,* "where all problems are solved in 45 minutes," promote "a somewhat skewed version of what science is and what scientists do."

Gary Lorden, chair of the mathematics department at the California Institute of Technology, is a consultant for the CBS prime-time drama *NUMB3RS,* in which an FBI agent and his genius professor brother use the power of math and physics to solve crimes. Lorden is often asked to produce specific sets of equations on a white board or computer screen that can be directly filmed, "so that if you froze the frame, it would generally describe what is going on," he said. Lorden admitted that scribbling a complete algorithm that can stand alone as a plot point is a difficult task, but he takes pride in making sure that what ends up on the screen is accurate.

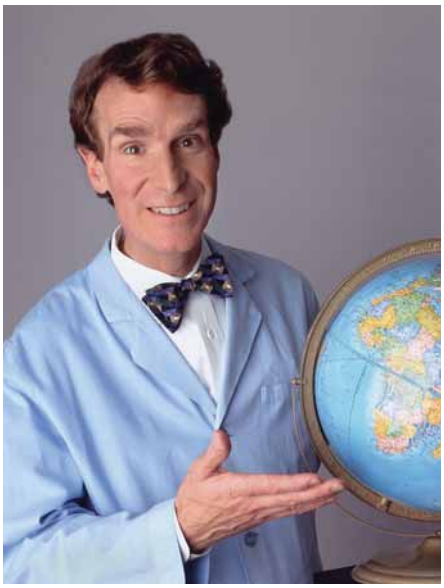
Very little cutting-edge research, the kind found in journals and on preprint servers, "is ready for prime time. It's too detailed and limited in scope," Lorden said.

Lorden has also asked the show's writers to include more of the setbacks that researchers face and the collaborations they rely on to solve their problems, an aspect of science that he said is lacking in many television shows. "One thing I've encouraged the show to do more of is to show Charlie [the professor] stumped, staying up late. And sometimes he's wrong, and that's great because of course that's real."



GARY LORDEN

GARY LORDEN



NYE LABS, LLC

PIONEER TELEVISION SCIENCE TEACHER WILLIAM S. NYE—a scientist, engineer, and comedian from *Almost Live*—originated the popular children's TV series, *Bill Nye the Science Guy,* and was one of the first to bring a sort of "gonzo" style to science on camera.

Mysteries, Controversies, and Gee Whiz

In the absence of scientific detail, some shows turn to supposed "controversies" or "mysteries" in a field to inject a little drama into their scripts. For instance, Lipps pointed out that the 1996 *The Mysterious Origins of Man,* aired on NBC, contained numerous factual errors obscured by a "conspiracy of scientists" storyline.

"That's simply not the way science works—we do not do conspiracies, period," Lipps said. "The essence of science is to disprove hypotheses, one's own and others'."

Other shows rely on "gee-whiz" experiments or stunning images from nature to boost excitement in their topic. On the first count, Bill Nye of the popular children's series *Bill Nye the Science Guy* was one of the first to bring a sort of "gonzo" style to science on camera. The technique attracted at least a few budding researchers, judging from the enthusiastic response given to Nye's show by the Tucson forensics students.

"He always did these experiments that were totally out there, but they were fun to watch," said Aileen Parker, a student at Catalina Foothills High School in Tucson, AZ.

Some kinds of science rarely make it to television in the first place, in any form. Palfreman noted that documentary producers realize that some of the most exciting scientific research looks boring on screen, and "in desperation some subjects, like chemistry, we abandoned entirely."

"Biology is typically shown in a positive light and chemistry in a negative light," Goll said. "Chemistry is most positively depicted as a good thing in reference to athletics and personal relationships."

Five Facts an Hour

Unlike celebrity gossip, family foibles, or even crime dramas, science on television seems to carry a special responsibility to be both educational and entertaining. Although some researchers would like to see more accurate science on their favorite shows, they are realistic about how much any program can do to educate non-scientists.

Writing about televised astronomy programs, British science documentary filmmaker Nigel Henbest said viewers seem to learn only about five new facts per hour of television. "Television is an excellent medium for entertainment, but a poor medium for information," he contended.

The twin goals of education and entertainment may overlap most naturally in children's programming, such as the award-winning *Science Court,* an animated show on ABC that put basic scientific concepts such as the water cycle "on trial."

"We wanted to address common misconceptions, and the courtroom provided a realistic forum for presenting and refuting evidence, having experts testify and embedding science in real-life, although humorous, situations," said David Dockterman, vice president of Tom Snyder Productions, which created *Science Court.*

"Our primary goal was to educate, but we also wanted children and their parents to tune in," Dockterman adds. "Infusing deep science content into a Saturday morning cartoon show competing against pure entertainment was a great challenge."

White Men in White Lab Coats

For many television viewers in the past, a scientist was a white man in a white lab coat. As actual labs in the United States have become more diverse, television has followed the trend at its own slow pace. According to a 1999 study that compared U.S. census numbers with the number of television scientists, television scientists are disproportionately white men, far more prevalent on the small screen than their numbers in the general population would suggest. Black, Hispanic, and Asian women are least likely to see themselves portrayed as scientists in prime time.

SCHOLASTIC INC.

THE ANIMATED CHILDREN'S SERIES *SCIENCE COURT* used a humorous courtroom setting to teach basic scientific concepts.

That image is changing, and there may be no better example than the *CSI* programs. *CSI* presents a multicultural cast of scientists, with plenty of females who combine brains and beauty. Some of *CSI's* characters are the classic geek. Many, however, give the public images of scientists who are quite human with lives outside the lab. Furthermore, Chaloner and some other researchers think that television has been better than real life at including women in the scientific community. "For dramatic reasons," she pointed out, "they [women] are more numerous in TV and film than in an average university chemistry department or industrial research laboratory."

The *CSI* Effect

CSI has gotten plenty of attention for raising unrealistic expectations about the capabilities of forensic science in the real world.

In real life, forensic evidence may not be collected at every crime scene because the criminals have cleaned up or local police lack adequate resources.

On *CSI,* DNA and toxicology test results appear almost instantly. In the typical criminal investigation, it may take days or weeks to get that information. *CSI* staff has access to all kinds of futuristic technology that remains a gleam in the eye of the individuals who use science to solve crimes.

Everyone seems to be expecting *CSI*-style investigations. Police, prosecutors, defense lawyers, and judges are seeing the results of this *CSI* effect.

Defendants' attorneys are spotlighting gaps in crime scene investigations. Jurors are refusing to convict without it. Consider one recent suburban Washington, DC, jury. It refused to convict a man accused of stabbing his girlfriend to death because a partially eaten hamburger, found at the scene and assumed to be his, was not tested for DNA.

—BH

Blurred Images of Chemistry

In a 2001 study of children's science education television programs, Colorado State University journalism professor Marilee Long and colleagues found that male and female characters on the programs were equally likely to be scientists, but that minorities were less likely to be labeled as scientists. When minority scientists did appear, they spent less time on screen than white scientists, Long and colleagues discovered.

Televised diversity may seem like a minor point compared with actual diversity, but Chaloner points out that most people do not personally know any real-life scientists, and therefore get most of their ideas about what scientists are like from the mass media.

By that standard, the general public meets very few chemists through TV. "I do not see chemists depicted as major characters or see it as a major part of shows," Goll said.

"I don't think chemists are portrayed as chemists," Warburton agreed. "They are labeled as scientists, with no discipline specified. I don't know if this makes a difference to students and viewers, though."

Chaloner and others noted that scientists on television and in the movies often fall into one of two categories: the crazy, disheveled lab rat detached from the real world, or the arrogant researcher who lacks common sense and meddles with nature at our peril. It may be the second stereotype that is most harmful to science, said William Evans, a former communications professor at Georgia State University. Evans said the skepticism necessary to do science is often scorned in recent television offerings such as the paranormal drama *The X-Files,* with scientists and the scientific method portrayed as "obstacles" to the truth.

Science from on High

Today's shows represent a change from the days when scientists in popular media were the voices of authority and expertise. In movies and television shows from the 1950s, Gary Lorden remembers, scientists "were almost priests. They seemed to be divinely informed."

Although regular *CSI* viewers may disagree, Goll thinks there are few problem-solving scientists on television today. "There are not the characters of Russell Johnson, the Professor on *Gilligan's Island,* or James Doohan, Mr. Scott on *Star Trek,* that used knowledge to solve problems and inspire young people to become scientists and engineers," he said.

On the other hand, the sheer glamour of *CSI* and similar shows has boosted the "cocktail party profile" of scientists, some researchers admit.

In the past when Warburton told strangers he was a chemist, "that would kill a conversation right on the spot. I had a friend who would say he was an accountant to avoid that," he jokes. Now, Warburton said, people start talking about *CSI* and ask him to explain everything from DNA profiling to chemotherapy.

THE SCIENCE CHANNEL

THE SCIENCE CHANNEL, launched in October 1996, is one of the latest offerings from documentary cable giant Discovery Communications Inc.

Production Assistance

Increasingly, scientists and television producers and writers are working together to create shows that have realistic science, realistic scientists, and the sense of wonder and discovery that most researchers love about their work.

"Science is enormously entertaining because it involves creativity, people with all the same sorts of problems as others, the hopes and dreams seen on sitcoms, and quite funny and adventuresome events," Lipps said.

As audiences become more technologically savvy, they demand more realistic settings and details for scientific plots, Warburton said. "The old days of the Van de Graaff generators and big computers with flashing lights, they won't accept that anymore when they see something like that in a show."

"The late Steve Allen of TV fame and I had discussed this some years ago. He noted that 80% of writers wanted to write about science, but when I asked him how many had sufficient scientific knowledge to do so, he said about 5%," Lipps said.

Several organizations, including the Hollywood, Health & Society Project at The Norman Lear Center, bring in researchers from the CDC to brief producers and writers on hot issues in science and health and provide accurate data for scripts. The National Institutes of Health, the Pentagon, and other government agencies now routinely answer technical questions from screenwriters and actively collaborate on new show ideas.

Consulting for a television show is a "serious commitment," according to Lorden, who estimates that he contributes 8 to 10 hours of work per episode. "But who would have thought that at this advanced stage in my career, my work would go out there to 12 million people?" ⬢

Becky Ham watched a lot of television while researching this article, and some days wound up with fuzzy images of everything—not just science. A science and medical writer in Tucson, AZ, Becky is a regular contributor to Chemistry.

strange but true

Tales from Science

BY BILL SONES AND RICH SONES

King Kong's death, *T. rex's* speed, mega career networks, and very long words are among the ingredients for a collection of strange-but-true vignettes from a journalist and a physicist who specialize in the anomalies and curiosities of science.

Print CARBON in red on a piece of paper and DIOXIDE in blue. Then ask guests at a party, or students in class, to eyeball the words through the long stem of a wine glass held over the paper. Notice that CARBON appears inverted but not DIOXIDE. How can this be?

Given the choice, which would you take: a 2006 Ferrari or a penny that doubles in value every day for a month?

"It was beauty killed the beast" in the original 1936 version of the movie *King Kong* as well as the 1976 and 2005 remakes. In the climactic scene in the 2005 version, Kong follows the script from the past. Ann Darrow bids the dying beast a tearful goodbye after Kong falls 1,250 feet from the Empire State Building in New York City. How realistic is Kong's death when put to the test with the law of falling bodies?

Could an automobile drive straight up a wall?

As the originators and authors of a syndicated newspaper column that delves into the anomalies and curiosities of science, we've found some strange-but-true answers to questions like these.

Most people expect trick questions like, "In which most recent year did New Year's precede Christmas?" (The New Year arrives before Christmas every year!) And they catch on pretty quick to challenges like the penny-or-Ferrari offer. (A wise person would take the penny. Go ahead, do the math. You'd be a millionaire on day 28, have $5 million in a 30-day month, and more than $10 million in 31 days.)

Other questions, like the CARBON and DIOXIDE mystery, can puzzle and perplex even Ph.D.s. The key here is remembering that the wine glass stem acts like a prism,

which breaks visible light into a spectrum. So, maybe the stem acts differently on the red and blue wavelengths? But that seems incredible. The "trick" is demystified when you view the words through the back of the paper, turned upside down. Get it now? The puzzle has nothing to do with color. Both words are inverted when viewed through the glass, but this is masked because DIOXIDE is symmetrical about a horizontal midline.

Try your luck at these challenging examples.

Gravity and the Beast

Some scenes in *King Kong* are good connects with scientific reality. After Kong captures Ann Darrow, for instance, he carries her to his mountaintop perch. After gently setting Ann down, Kong roars, bares his teeth, and pounds his chest. This behavior may not be just aggressive but an attempt by the mega-alpha male to impress a female. Ann catches on, by the way, and is not frightened.

But how realistic is the climactic scene in which Kong falls from the Empire State Building? Not very; it would be quite a bit messier if it stuck to the laws of physics. A creature as big as Kong, falling from such a great height, should have hit the ground with a force not bone-crunching but body-splattering, said Michael LaBarbera, a biologist and anatomist at the University of Chicago. "Pink mush would have covered the streets of Manhattan."

While small creatures easily survive long falls because air resistance slows their speed significantly, big ones get—quite literally—creamed. This simple fact was the origin of a common medieval strategy: Let the dead body of a horse ripen a few days in the sun, then catapult the horse over the wall of a besieged town. "On impact, the carcass would indeed splash, spreading contagion throughout," said LaBarbera. Contagion and stink!

WHEN WINNING *WAS* EVERYTHING
This stone goal was the goal for Mesoamerican teams in the ball court at Chichén Itzá, a famous ancient Mayan archeological site near Cancun, Mexico. Two teams played on the court, which was larger than a modern football field, trying to get a rubbery ball through the hole. Players could only touch the ball with their elbows, knees, or hips. Getting a goal was so difficult that games often went on for days. One goal usually ended the game—and the lives of the loosing team.

Tell *Them* Winning Isn't Everything

What's the toughest thing to do in all of sports? "In terms of physical difficulty, I've heard persuasive arguments that the biathlon [cross country skiing and rifle sharpshooting] is the toughest because it requires the body to do two very different and contradictory things at the same time," said sports historian Mark Dyreson at the Pennsylvania State University. First, the athlete skis intensely, raising heart and respiration rates and creating other physiological manifestations of dynamic aerobic exercise. Then, the athlete must quickly slow the heart and breathing to shoot effectively—no easy feat.

From an anthropological viewpoint, the toughest thing to do in all of sports was to be a member of the losing team in a Mesoamerican ball game. This game, which held deep religious and political significance among the Maya, Aztec, and other Mesoamerican civilizations, was played for thousands of years in ancient Mexico and Central America and spread in various forms into much of North America. The game was brutal and violent, injuries were common, and the consequences for the losing team were devastating. "Captains of losing squads, and sometimes the entire losing team, were sacrificed to the gods—giving a new meaning to the old cliché that winning isn't everything," said Dyreson. "It's the only thing."

Climbing the Walls

How steep a hill could a car climb: 10°? 20°? Don't try this in your neighborhood, but a car could drive straight up a wall. Yes, a 90° angle.

Ten degrees doesn't sound like much, but it's actually a pretty steep incline. Still, a car could do it fairly easily. The power train of a typical passenger car can develop torque equivalent to about half the vehicle's weight, said Thomas D. Gillespie (ACS '57), a professor of automotive engineering at the University of Michigan. So, most cars could ascend a slope of up to 30°.

Four-wheel-drive vehicles with low range can do better, and many have the power to "go vertical." Top dragsters would perform the best, said Gillespie. At launch, dragsters accelerate at 5 *g*'s or more, the force of which would be equivalent to climbing a wall while dragging four other dragsters behind!

But these predictions consider only raw horsepower. Next problem: sufficient friction of tires against the driving surface. It's trickier to model, but mechanical and computer engineering specialist Ian Charnas poses a way to make vertical travel possible: Build a road that starts flat and curves slowly upward. As dragster speed builds, the road curves up more and more steeply. The vehicle should be equipped with spoilers—like upside-down airfoils—shaped not for lift but for downward pressure, to lend added frictional force against the driving surface. Given sufficient power train and speed, plus the right road curve and spoiler aerodynamics, the dragster just might be driven skyward! Heavens to old rocketin' Betsy!

To take this idea over the top (beyond 90°, that is), a 2001 Bentley EXP Speed 8 reportedly develops 3,094 pounds of downward force at 150 miles per hour (mph). Because the car weighs only 2,020 pounds, Charnas explained, "there would be no problem driving it upside down!"

STRANGE BUT TRUE VEHICLES
Could this 2001 Bentley EXP really drive upside down?

Curses!

If somebody put a voodoo curse on you, might it kill you? If you really believed that it could, then it might.

In the sixth edition of *Essentials of Psychology: Exploration and Application,* Dennis Coon describes a terrified young woman admitted to a hospital because she believed she was going to die. A midwife had predicted that the woman's two sisters would die on their 16th and 21st birthdays and that the woman herself would die on her 23rd birthday. Her sisters had died as predicted, and she arrived at the hospital three days before her 23rd birthday. The following day the woman was indeed found dead in her hospital bed, "an apparent victim of her own terror."

Other cases of people dying of fright have been reported, such as soldiers in particularly savage battles and ordinary people under intense emotional stress (e.g., Louis Armstrong's widow, who suffered a heart attack during a memorial concert for her husband just as the final chord of *St. Louis Blues* was played).

Such victims may die in one of two ways, said Coon. Intense emotion causes several physiological reactions: Blood sugar increases sharply, the heart beats faster, digestion slows or stops, and blood flow to the skin decreases. These fight-or-flight reactions generally improve the chances of survival in an emergency but also could kill a person who is old or in bad health.

If the initial physiological response doesn't prove fatal, then parasympathetic rebound might do it. After such heightened arousal, the body works to calm all the accelerated processes and, in doing so, may go too far. Even in a young, vigorous person, this reaction may actually stop the heart.

Thus, voodoo—like all terrors—can get you coming or going.

NEW ORLEANS HISTORIC VOODOO MUSEUM

COULD A VOODOO CURSE REALLY KILL?
Marie Laveau's brand supposedly was lethal. Laveau (1794–1881), then the "Great Voodoo Queen of New Orleans," was the most famous and powerful voodoo queen in the world.

Supersonic Solo

Heard about the guy who broke the sound barrier without being in a vehicle of any type? The speed of sound is about 760 mph at sea level, and military jets top that speed routinely. Space shuttle astronauts zip along at almost 18,000 mph while orbiting Earth. However, breaking the sound barrier without a vehicle is possible and most likely already was done more than 40 years ago by a fearless parachutist.

On August 16, 1960, space pioneer Joseph Kittinger ascended to 103,000 feet (19.5 miles) in a balloon gondola, then jumped. Without his pressurized suit, he would have met near-instant death in the rarefied air of the stratosphere. As he fell through thin air and temperatures near –100 °F, he experienced difficulty breathing and suffered a frozen hand.

Unlike an ordinary skydiver, whose speed would have topped off at around 200 mph due to air friction, Kittinger kept accelerating through 16,000 feet or more to speeds of 650–700 mph and probably beyond. Another factor helping him "break the barrier" is that sound travels slower in cold, thin air, so he only had to beat the local speed of sound—more like 650 mph (rather than 760 mph).

So, Kittinger probably was "the first human to go supersonic in freefall," as *Air Force Magazine* claimed. His speed slowed as the atmosphere thickened and would have decreased to about 250 mph by 50,000 feet. A small drogue chute stabilized his drop to prevent the rapid spinning that could have caused him to black out. Total freefall time: 4 minutes, 37 seconds (followed by an 8-minute main parachute descent to New Mexico's White Sands Missile Range).

Just before leaping off the gondola (on which a sign announced, "Highest step in the world"), a nervous Kittinger had radioed to the ground crew, "There is a hostile sky above me, void and black. Man may live in space, but he will never conquer it." But he conquered 103,000 feet of it on that day.

UK PARACHUTING

SUPERSONIC SKYDIVING?
Mach One isn't even close for this brave trio, but a skydiver theoretically could break the sound barrier.

Baring It All About Beer

What is there to say about beer that you haven't heard before? Try this: When you pop the cap off of a bottle, carbon dioxide molecules shoot out the bottleneck at speeds rivaling those of a bullet shot from a rifle, said Craig F. Bohren in *Clouds in a Glass of Beer.* Or this: The racing molecules leave behind the more sluggish ones, creating a bottleneck zone where temperatures plunge to –30 °F, triggering condensation and the wispy vaporous beer clouds well-known to elbow-benders.

Also, beer is generally bottled under a pressure of 30–45 pounds per square inch (psi), which holds in the fizz and causes the opening "pop." But what if someone shook the bottle long and hard beforehand: Wouldn't the bottle eventually explode? No: You can shake and shake until the cows stagger home, but you won't add any gas—hence no extra pressure, and no bottle blast. All that happens is that the agitated gas mixes with the liquid more thoroughly and drags a lot along upon uncapping. Got a mop handy?

Finally, have you ever seen an open beer bottle get "popped"? Here's how it works: Some poor sucker sets an unfinished longneck on a table, and along comes a wiseacre who hits that bottle on the rim with the base of another bottle. Then the bottle on the table erupts like Vesuvius. What probably happens is that a sound wave is unleashed in the liquid, creating high- and low-pressure zones. Inside the low-pressure regions, activated microscopic bubbles expand like mad, creating the wet whoooooooosh that ensues.

WASHBURN UNIVERSITY

HORSE VS. *T. REX* IN THE KENTUCKY DERBY
Place your bets, ladies and gentlemen! Which will it be—the thoroughbred horse or the dino? Strange as it may seem, the horse would probably leave the dino in the dust.

T. Rex Runs for the Roses

May's big race at Churchill Downs in Louisville, KY, is an annual classic that leads off competition for the Triple Crown. Imagine for a minute a time-warp Kentucky Derby—or Preakness, or Belmont Stakes—in which a 12,000-pound bipedal *Tyrannosaurus rex* (*T. rex*) chases a 1,000-pound four-footed racehorse. Could the thoroughbred escape?

Horses are good middle-distance runners, with legs and a body structure well-suited for speed and stamina, said Nancy Nicholson, an interdisciplinary studies professor at Miami University. The rocking fore and aft of a galloping horse probably helps pump air in (rock back) and out (rock forward), much like a piston in an engine.

Computer models suggest *T. rex* was no slouch either, with amazingly complex motions during a stride, and feet possibly best for straight line runs or gentle curves.

Moment of suspension is a fascinating factor, where for a galloping horse all four feet come off the ground simultaneously—a moment of friction-free air glide. "It makes no sense to assign such a moment to a beast the size of an adult *T. rex,* because of the huge forces in falling even a few inches."

So, credit the horse on this one, and debit the dino on its ecological role as cleanup crew on large kills by other species—a task that doesn't require blazing speed.

Put it all together, concluded Nicholson, and a racing horse may reach speeds of 40 mph, whereas the dino reached a highly speculative 10–25 mph. "So, for a mile-and-a-quarter on a curved track, I vote for the horse by a factor of 2, with terror likely inducing an inspired performance on the part of the horse," Nicholson added. "On a straight track for that distance, I would think the difference would be less but still vote for the horse to win the Triple Crown."

Cast a BIG Net

Everyone recognizes the importance of career networking—and not only when in the midst of a job search. Making and cultivating contacts should become a part of your daily routine. These activities will ensure that the network will be there when needed and that it constantly works on your behalf as you strive to climb the career ladder.

Stay connected and involved at work, in school, and socially. Talk to people, volunteer for projects and committees, join clubs and sports teams, attend social events, get to know associates, and make friends. Just how many acquaintances do you need to sustain a really big network? Again, do the math.

Suppose you know 300 people—an average number. You've met each of these people, and you count many of them as friends. At the least, you'd recognize each one on the street and probably be friendly enough to exchange greetings. If each of these people knows 300 other people, then you're now friend-of-a-friend to 90,000 people and have a huge career network. You also are friend-of-a-friend-of-a-friend to 27 million people! Even with overlaps, the your network is truly enormous. When a new career opportunity arises, the odds are good that someone will utter those helpful, door-opening words: "Well, you know, I have a friend whose friend has exactly those qualifications. …"

That's a Mouthful!

Ask someone to name the longest word in the English language, and you'll probably hear *antidisestablishmentarianism,* a 28-letter word that means "opposition to the disestablishment of the Church of England." But such a person would only be repeating a deeply enrooted notion that is dead wrong.

According to Richard Janda, a linguist at Ohio State University and co-editor of the *Handbook of Historical Linguistics,* the actual longest word in most unabridged dictionaries is the 45-letter tongue twister *pneumonoultramicroscopicsilicovolcanoconiosis,* which is a lung disease caused by the inhalation of very fine silica dust. Most people would count themselves fortunate not to have to spell this word—or even the 29-letter word that previously held the appellation as the longest word in the 20-plus-volume *Oxford English Dictionary: floccinaucinihilipilification,* a mouthful that means "the action or habit of estimating something as worthless."

Luckily for English spellers, Janda pointed out, English is not a polysynthetic language like that of the Inuit people in the North American Arctic. Such languages use huge numbers of prefixes and suffixes to add increments of meaning to words, which commonly grow as long as English sentences. ⬢

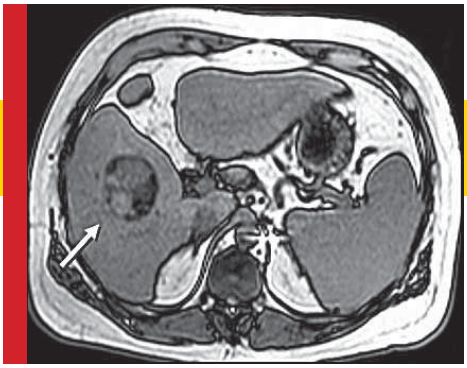
STRANGE SYLLABLES

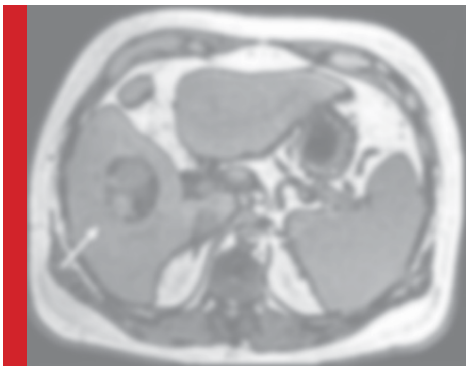
pneumonoultramicroscopicsilicovolcanoconiosis

floccinaucinihilipilification

antidisestablishmentarianism

Bill Sones is a freelance journalist whose articles have appeared in Reader's Digest, Discover, Family Circle, *and other publications. Rich Sones is a Ph.D. physicist who holds a dozen patents. The two brothers write a weekly column, "Strange but True," for about 80 newspapers. They co-authored* Can a Guy Get Pregnant? Scientific Answers to Everyday (and Not-So-Everyday) Questions *(Pi Press: New York, 2006).*





A NEW AGE OF

Imaging Agents

BY PATRICK YOUNG

Contrast agents have been unheralded heroes in helping physicians diagnose and treat diseases. A new generation of these chemical compounds sharpens otherwise fuzzy images of internal organs, promising to sustain and enhance that rich heritage.

Diagnosis: Prostate cancer
Recommended treatment: High-dose radiation
First step: CT scan enhanced by a contrast agent

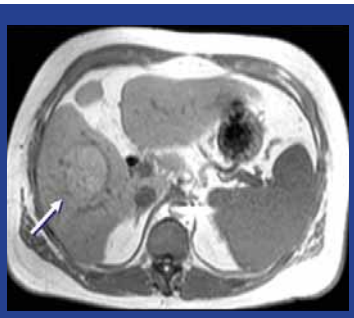
A radiation therapist at the Sidney Kimmel Comprehensive Cancer Center at Johns Hopkins University approached me carrying two small Styrofoam cups. One contained MD-Gastroview, a contrast agent that would make my colon visible on the computerized tomography (CT) scan. My radiation oncologist ordered the scan to help plan the series of X-ray treatments that lay ahead in my battle against prostate cancer.

"Some people tell me it tastes bitter," the therapist warned, referring to the combination of diatrizoate meglumine and diatrizoate sodium in MD-Gastroview. It did, and I washed away the taste with water from the second cup.

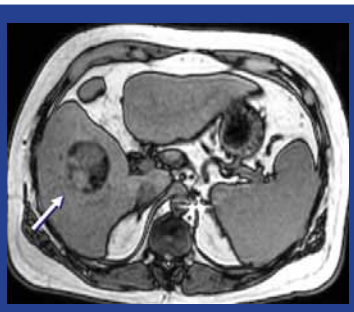
But MD-Gastroview did its job, just as many unheralded chemical compounds—invaluable aids in the diagnosis and treatment of disease—do for millions of patients each year. The results of the CT scan brought an immediate sense of relief and reassurance: My colon was situated well above the area of my urinary bladder, which would be the target of radiation therapy. That anatomical twist reduced my chances of serious bowel damage from the X-rays to less than 1%—or, as my wife Leah said, to "almost zero."

Example of an Hepatocellular Carcinoma (HCC) on MRI

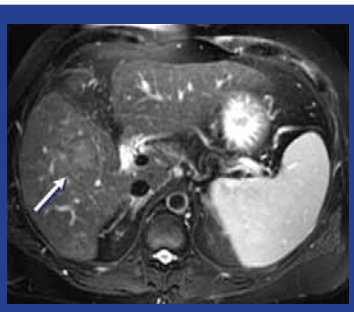
This is a tumor commonly seen in patients with cirrhosis of the liver.



T1-weighted image with the water and fat protons in-phase shows a hyperintense mass in the liver.



T1-weighted image with water and fat protons out-of-phase reveals that the mass drops out indicating fat content.



T2-weighted image with fat suppression reveals that the mass has subtle hyperintensity.

T1-weighted image post Gadolinium-chelate administration intravenously during the arterial phase reveals a hyperenhancing mass.

RENDON C. NELSON

As their name suggests, contrast agents—also called imaging agents—provide contrast that allows physicians to more clearly distinguish a specific body part, system, or function from surrounding tissue. By doing so, they paint a valuable picture of a pathological condition or disease process.

"You can perform some imaging studies without contrast agents," said Rendon C. Nelson, M.D., professor of radiology at Duke University Medical Center. "In other studies, contrast agents give you an order of magnitude more information than you would get without them. For example, if I do an unenhanced CT scan of the liver and see a dark spot, I know there is a mass there. But the mass may be benign or malignant, or sometimes it's just fat. The enhancement pattern given by a contrast agent can be highly diagnostic. Often I can tell whether a mass is a metastatic tumor or completely benign and avoid doing a biopsy."

A Future That Depends on Chemistry

With new compounds in the laboratory and in the pharmaceutical industry's pipeline, imaging agents are poised to make even greater contributions to medicine and patient care. One agent well along the approval path at the U.S. Food and Drug Administration (FDA) will allow the first contrast imaging of lymph nodes to detect the spread of cancer. Also on the way are blood pool agents, which do not leak from blood vessels quickly, like conventional contrast agents do; as such, they will enable the prolonged imaging of arteries and veins.

Molecular imaging agents will one day target only a specific molecule. And far from center stage but perhaps the most exciting prospects are the biochemically activated imaging agents, each one sensitive to a specific biological process. Only when the target process occurs—say, new blood vessels form—can the agent be imaged.

"Chemistry drives the field forward," said Thomas J. Meade (ACS '81), the Eileen M. Foell Professor of Chemistry; Biochemistry and Molecular and Cell Biology; Neurobiology and Physiology, and Radiology at Northwestern University. "Each modality requires contrast—not just contrast in the anatomical sense but in a smart sense. The future of imaging depends on chemistry,"

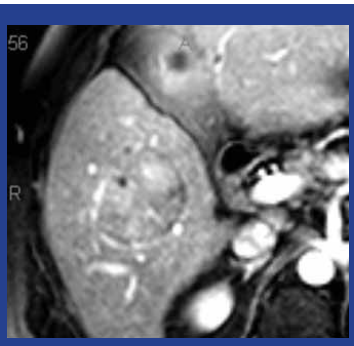
A Century's Worth of Images

Physicians began using contrast agents shortly after Wilhelm Roentgen's 1895 discovery of X-rays. Because bone is so dense, X-rays allowed easy viewing of the skeleton to detect fractures and, in one early case, a needle embedded in the pad of a patient's foot. But soft tissues like lungs, stomach, and kidneys posed a challenge. Tissue that is less dense than bone often appeared as a fuzzy blur on X-rays, and because of the small density difference among types of soft tissue, distinguishing an organ from its surroundings was difficult. Physicians needed ways to highlight specific body parts.

Contrast agents were first used in the early twentieth century. Bismuth and barium outlined the stomach and duodenum (the first part of the small intestine) when administered orally and enabled the diagnosis of gastric ulcers and cancer. Other agents, administered rectally, helped physicians diagnose colon cancer and diverticulosis. New contrast agents developed between 1906 and 1912 allowed physicians to noninvasively visualize blood vessels, the bile duct, and the gallbladder. An injectable mixture of iodine and poppy seeds introduced in the early 1920s provided good-quality images of lungs and their air passages. Angiography, first performed in 1929, enabled the imaging of arteries inside the heart and the diagnosis of potentially fatal blockages that occur in people who have atherosclerotic heart disease.

Example of an Hepatocellular Carcinoma (HCC) on MRI

(continued)



T1-weighted image post Gadolinium-chelate administration intravenously during the venous phase reveals a subtle slightly hyperenhancing mass.

T1-weighted image post Gadolinium-chelate administration intravenously during the equilibrium phase shows that the mass has washed out but now demonstrates a thin capsule.

A fat-containing mass that hyperenhances during the arterial phase and has a capsule is virtually diagnostic of hepatocellular carcinoma in the appropriate clinical setting.

RENDON C. NELSON

X-ray machines were the mainstays of internal imaging throughout the first half of the 20th century. In the 1950s, however, ultrasound and nuclear medicine expanded imaging's horizons. In nuclear imaging, a small amount of a radioactive tracer concentrates in the target organ or body structure, thereby revealing size, shape, position, and perhaps information about its function. Nuclear imaging applications began in 1955 with the use of inhaled xenon-133 to image the lungs. A few years later, technetium-99m debuted and quickly became a widely used radioisotope for medical imaging. Today, about 85% of diagnostic imaging procedures in nuclear medicine—about 20 million each year—rely on technetium-99m. About half are bone scans, and the rest include kidney, heart, and lung scans.

Ultrasound proved its value in detecting atherosclerosis in the 1960s and has become the most popular technique for imaging blood vessels, partly because it is noninvasive, needs no ionizing radiation, and is less expensive. Ultrasound also is valuable for tracing blood flow in cancer tumors and in organs such as the kidney and liver.

CT and magnetic resonance imaging (MRI) were introduced in the 1970s only to become major imaging technologies in the 1980s. In 1976, researchers demonstrated that CT could produce images of metastatic tumors in the lungs. MRI, the medical application of nuclear magnetic resonance, came into its own with the demonstration that it could image tumors. Although MRI initially was envisioned as a stand-alone imaging technique, users soon found that certain scans benefited from the addition of contrast agents.

Contrasting the Agents

Contrast agents can be administered orally, rectally, by injection or infusion, or even as a gas (for certain lung and brain studies). Specific agents are used for each imaging technology. "For example, in angiography, the contrast agent gadolinium DTPA (diethylenetriamine pentaacetic acid) enhances the visibility of vessels," said Yantian Zhang, a program director at the National Institute of Biomedical Imaging and Bioengineering (NIBIB), part of the National Institutes of Health. "It does not create the same effect with ultrasound or a CT scanner."

Ultrasound imaging relies on three categories of contrast agents: microbubbles, liposomes, and perfluorocarbon emulsion nanoparticles, typically 0.1–0.8 micrometers (μm) in diameter. Blood is less "echogenic" than tissue, and these agents increase the reflectivity of the ultrasound waves to permit the imaging of vessels as small as capillaries. CT scans use barium- and iodine-based contrast agents in concentrations that vary depending on the part of the body to be imaged. MRI contrast agents (primarily small-molecular-weight paramagnetic compounds) enhance the magnetic relaxation in tissue that underlies the technique and appear bright (positive) or dark (negative) on an image.

One major research need in this field is the invention of contrast agents that can be used with more than one imaging technique. "Developing multi-imaging modality contrast agents is high on many people's agendas," Zhang said. "One example would be an agent for MRI and optical scanning. The information provided by each imaging modality complements the other."

To all investigators developing new imaging agents, academic and pharmaceutical, the creed is the same: First, do no harm. Ultrasound has a low incidence of adverse side effects, and patients tolerate MRI contrast media better than those used with X-rays. Even though imaging agents have a good safety record, some patients experience mild side effects, such as a warm sensation, a metallic taste, or itching. More serious and much less common reactions include tissue damage, kidney problems, and severe allergic reactions.

YANTIAN ZHANG

DARRYL J. BORNHOP (ACS '79)

THOMAS J. MEADE (ACS '81)

"In developing a contrast agent, you have to keep in mind not only its efficacy or potential utility; you must think about safety," said Darryl J. Bornhop (ACS '79), professor of chemistry at Vanderbilt University.

Excitement over Combidex

The investigational agent Combidex (ferumoxtran-10), an MRI contrast material, intrigues cancer specialists because it can reveal cancer cells that have spread to lymph nodes. It consists of iron oxide nanoparticles that accumulate in macrophages, which are present in normal lymph nodes but reduced or absent when cancer cells replace normal tissue. On an MRI scan with Combidex, cancerous tissue in lymph nodes appears light, and normal tissue appears dark.

"The FDA hasn't approved Combidex yet, but it has huge promise," said Nelson. "Right now, enlarged size is our only criteria for an abnormal lymph node." So if you have a small node with cancer in it, you are going to call it normal, and if you have a node that is big for a nonmalignant reason, such as infection, you will call it cancerous. With this agent, we can find small tumors, and that is exciting."

Combidex's development began with a serendipitous observation. Researchers at Advanced Magnetics, Inc. (Cambridge, MA) noticed that a small amount of one of its investigational agents—now approved for liver scans as Feridex I.V. (ferumoxides)—also went to the lymph nodes. "In talking to physicians, we learned that there was a serious diagnostic problem in telling whether a patient's cancer had spread to the lymph nodes," said Paula Jacobs, the company's vice president for development.

However, tailoring a drug to image lymph nodes proved difficult. The drug needed a long half-life in the blood to accumulate adequately in lymph node cells. Researchers solved that problem by creating iron oxide crystals about 6 nanometers (nm) in diameter and coating them with Dextran to yield a 30-nm particle. Still, other challenges remained. "Combidex is a colloid, and there are not a lot of injectable colloid drugs," Jacobs said. "It had to be made sterile, endotoxin-free, and stable." In addition, "Combidex is freeze-dried. The challenges of freeze-drying a colloid and bringing it back up as a solution are not insignificant."

The FDA has told Advanced Magnetics that it regards Combidex as an approvable drug. But first it wants evidence of the agent's efficacy in detecting the spread of specific cancers, such as those in the breast or prostate.

Blood Pool Agents

Contrast agents used in CT and MRI are small molecules that quickly leak out of blood vessels into interstitial space and reach equilibrium in 2.5 minutes or less. Blood pool agents under development for these two imaging techniques consist of large molecules that remain in the blood for extended periods and provide high-resolution images of vessels. "If you can look longer, the possibility of seeing disease will be enhanced," said Bornhop.

Cardiologists foresee MRI blood pool agents greatly improving their ability to examine blood vessels—especially the extremely small arteries of the heart—with exquisite resolution. Cancer specialists envision the agents enhancing both the detection of solid tumors and the monitoring of therapies meant to destroy those tumors. For example, because tumors require new blood vessels to grow, several drugs aim to thwart vessel formation (called angiogenesis); oncologists then could use blood pool agents to determine whether a therapy blocks new vessel growth. "The problem now is that tumors take up a lot of contrast, and they wash out because of equilibrium. They

become invisible on the image," said Nelson. "So the idea is to keep the contrast inside the tumor blood vessels longer."

Doing so poses a formidable challenge, for several reasons. "One is toxicity," Bornhop explained. "The body is really efficient at identifying toxins and foreign species, and its responses are considerably higher for larger molecules than for smaller molecules. The second issue is solubility. You can make large molecules that are relatively soluble, but then you have a third issue: Distribution and transport through the body is dictated by size. A large molecule is not going to make it through the liver or kidneys more than one pass, if that. It will be trapped and processed."

Resolving these issues requires modifying the molecules so they remain in the bloodstream longer without causing toxicity. A commonly used approach is to bond a contrast agent to a common protein in the blood, such as albumin. "After bonding, the size increases dramatically, but the compound is more resistant to excretion by the kidney," said NIBIB's Zhang.

MALLINCKRODT

AN IMAGING AGENT used for radiographic examination of the esophagus, stomach, proximal small intestine, and colon.

Molecular Imaging

Molecular imaging has attracted interest because of its potential to diagnose disease and even treat some ailments more specifically than previous diagnostic tools. The key lies in finding a biological marker, such as a receptor on a cell, that indicates the presence of a disease—and only that disease—and then constructing a contrast molecule that will seek out and attach to that marker. "If you can design a way to visualize that marker, then you have a much more specific way of seeing what is truly going on instead of just the morphological changes," Zhang said. "You can see the biological changes associated with the beginning of disease or its early stages."

How applicable molecular imaging will prove to CT and MRI remains to be seen. Can researchers find ways to attach enough contrast to a biomarker for it to show up on a scan? "CT and MRI will probably not be useful for molecular imaging in the near future," Nelson said. "Most of the hope now in molecular imaging hinges on nuclear medicine."

Bornhop and his team at Vanderbilt have developed novel lanthanide chelates as molecular imaging agents for MRI, positron-emission tomography (PET), and CT, but their most intriguing experimental efforts concern contrast materials for optical scanning. "Our work has been oriented at developing agents that can be delivered in the blood but will localize in disease," Bornhop explained. "We have developed some different chelate chemistry to make molecules that are brightly luminescent. The idea is to make a family of molecules for imaging agents that could be targeted to different receptors."

For example, the team has targeted a protein called the peripheral benzodiazopine receptor, found on the membrane of mitochondria, which are the energy sources inside cells. Evidence suggests that in some cancer tumors, cells overproduce this receptor. However, the depth of optical imaging is slight, and so far, the Vanderbilt researchers have focused largely on surface malignancies, such as skin, colon, and cervical cancer.

"One main target is oral cancer," Bornhop said. "One would give this as a topical agent, let it equilibrate, wash off the excess, shine blue light on it, and look for reddish-pink fluorescence. It could serve for early detection and as a guide during biopsy and surgery, to ensure the removal of the entire tumor."

Targeted Therapy

Even more exciting than disease detection is the concept of using imaging agents in treatment. Could the same agent that detects atherosclerosis deliver a means to reduce it? "Why not?" answered Bornhop. "That is what nanomedicine is all about—making a molecule that has more than one function. We would like to make agents that signal a disease, deliver a therapy, and tell you if the disease has been abated or cured."

Targeted therapy delivers a treatment—a drug, toxin, or radioactive particle—directly to the disease site without exposing other tissues. By altering the surface of a contrast agent that homes in on a biomarker for a specific disease, researchers could create a means of both diagnosing and treating the ailment. "That is one side of targeted contrast agents," Zhang said. "The other is using contrast agents in the drug-discovery-and-development process."

The FDA often uses the survival rates of patients treated with an experimental drug as the gold standard of its efficacy. However, a statistically significant survival curve can take years to develop. Using targeted contrast agents to determine whether a treated condition persists could provide a means of assessing survival rates. "You see not only a cancer shrinking with the treatment, but the specific biological changes and bioactivity related to the treatment," Zhang explains.

Researchers are working on targeted contrast agents for all the major imaging techniques. For example, ultrasound specialists have attached various biologically active molecules to microbubbles and liposomes in searching for ways to noninvasively detect disease and study gene expression, drug localization, and the molecular mechanisms of diseases.

BERLEX IMAGING

FIRST MRI CONTRAST AGENT
When Magnevist (gadopentetate dimeglumine) was introduced in 1988, it ushered in the revolutionary concept of contrast-enhanced magnetic resonance imaging (MRI). Magnevist became the world's first contrast agent for use in MRI. The product is still the MRI market leader, used in imaging the head, neck, and parts of the body. MAGNEVIST has been used in more than 45 million MRIs in more than 100 countries.

Biochemically Activated Agents

At the cutting edge of contrast media research stand the teams—perhaps half a dozen worldwide—exploring the creation of imaging agents that become activated only by a specific biochemical process. "These new classes of MRI agents represent a substantial leap in the type of information derived from imaging experiments," said Meade. "We developed the first multimodal contrast agent for MRI and optical imaging in 1998, and we have been using it for years in a number of applications, including stem cell migration. We can make these agents for use inside or outside cells, inside or outside organs."

Meade and colleagues at Northwestern have created multimodal agents that consist of gadolinium resting inside a cage structure that resembles a tennis ball cut in half, then secured at four opposing points by a specific enzyme whose presence serves as a marker for a targeted process. The cage and cap prevent the gadolinium from being detected by MRI. Upon cleavage, however, the cap and cage open, exposing the gadolinium. The MRI's detection of gadolinium indicates the presence of the targeted biochemical process.

"By coupling the unique properties of nanomaterials with new types of biochemically activated contrast agents, we can develop an entirely new generation of probes," Meade said. "Researchers want to correlate the genetic activity during a developmental event. Now we've got a family of contrast agents that allows us to peer into physiological and biochemical processes, not just anatomy." ⬢

Patrick Young is a freelance science and medical writer and is former editor of Science News *magazine. He is writing a book about his experiences as a prostate cancer patient.*

CROSSWORD solution

TO SPRING 2006 *CHEMISTRY* PUZZLE.

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BY RANDY WEDIN

Is Nanotechnology Safe?

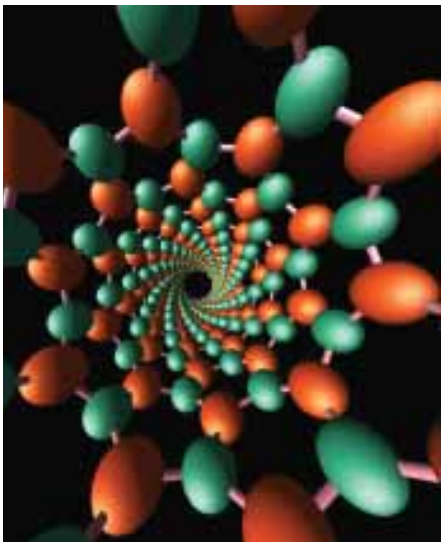
Leaders from industry, academe, and environmental groups agree on the need to understand the potential risks of nanotechnology before the small technology makes a big splash.

The chief executive officer of the world's third-largest chemical company and the president of a leading nonprofit environmental organization may seem unlikely to agree on a major public policy issue.

But these two leaders—Chad Holliday, Jr., chairman and CEO of DuPont, and Fred Krupp, president of Environmental Defense—coauthored a *Wall Street Journal* op-ed article. In "Let's Get Nanotech Right" (June 14, 2005), the authors urged improved understanding of the environmental safety and health (ESH) aspects of nanotechnology. "An early and open examination of the potential risks of a new product or technology is not just good common sense—it's good business strategy," they wrote.

In the months since then, a flurry of national and international reports, congressional hearings, and conferences has further heightened the visibility and urgency of this issue.

Why all the fuss? Why now?



VIN CRESPI, PENNSYLVANIA STATE PHYSICS

A VIEW DOWN THE MIDDLE of a boron nitride nanotube

Big Benefits

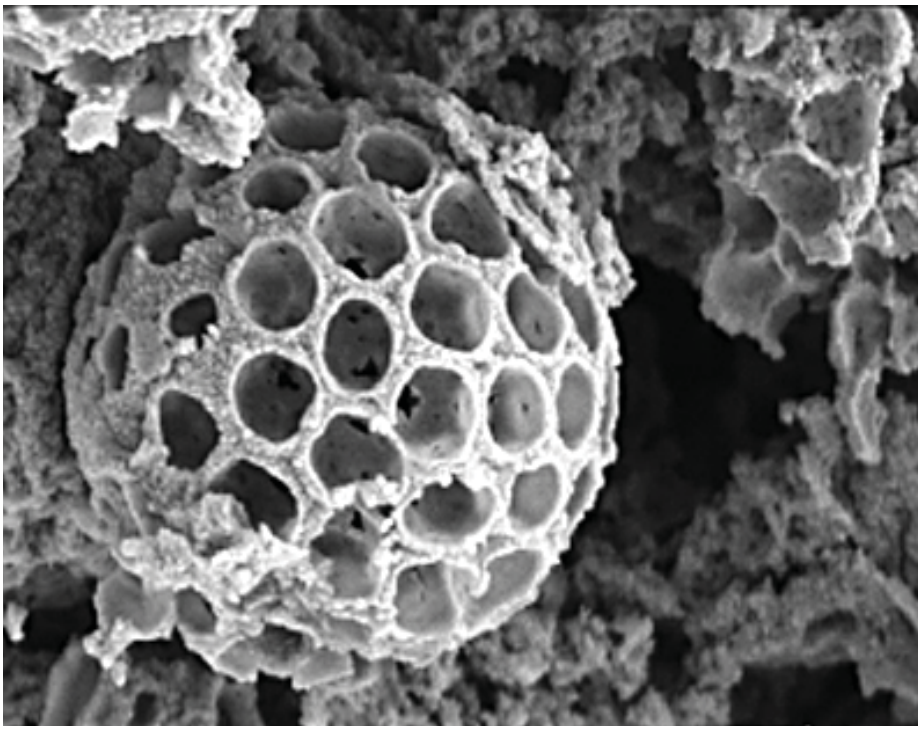
Industry, government, and media leaders have realized that nanotechnology is more than just the latest buzzword. These very small materials are about to become very big business, with a global economic impact that could reach $1 trillion annually by 2015, according to the National Nanotechnology Initiative (NNI). That interagency consortium (www.nano.gov) oversees the federal government's nanotechnology activities.

Dozens of consumer products incorporating engineered nanomaterials are already in the marketplace—from sunscreens to tennis racquets, contact lenses to car bumpers. And more are on the way.

NNI defines the "new nanotechnology" that is garnering all this interest as "the understanding and control of matter at dimensions of roughly 1–100 nanometers to produce new structures, materials, and devices." In this nanoworld where both classical and quantum effects can be important, scientists and engineers are learning to build and refine nanomaterials that may demonstrate properties not found in bulk materials.

The unconventional physical and chemical properties of a nanomaterial include different conductivity, reactivity, and optical sensitivity. They result from factors as varied as small size, chemical composition, surface structure, solubility, shape, or aggregation.

Consider one specific example: nanoparticles in sunscreen products. ZnO and TiO_2 are increasingly used to provide ultraviolet (UV) protection in cosmetic and personal care products. The new sunscreens contain engineered nanoparticles so uniformly small that they don't scatter light, leaving the end product clear instead of white. And that's a big benefit in the cosmetic industry.



SASCHA KLEIN, FRED LANGE, AND DAVID PINE, UNIVERSITY OF CALIFORNIA, SANTA BARBARA

TITANIUM DIOXIDE MICROSPHERE 1–50 microns in diameter

However, nanotechnology is a whole subset of technologies destined, perhaps, to serve as enabling technologies across many industrial sectors. The new improvements that result may be in fields as diverse as electronics, optics, sensors, materials, environmental improvement, medical imaging, catalysis, and drug delivery.

Risks and Unintended Consequences

The unconventional physical and chemical properties of nanomaterials that promise so many benefits also raise concerns about potential risks. Mindful of past technologies with unanticipated effects (such as chlorofluorocarbons, asbestos, and DDT), leaders vow to "get things right this time."

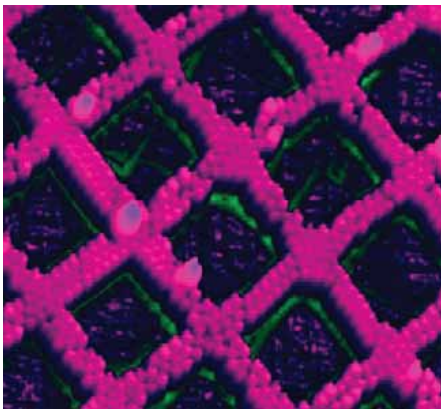
Nanotechnology carries a laundry list of potential risks. One recent review article in the February 3, 2006, edition of *Science* cited a dozen potential toxic effects of nanomaterials. They include the generation of reactive oxygen species (ROS), protein denaturation, mitochondrial perturbation, and uptake by nerve tissue.

With such a broad range of concerns, how do scientists, industry leaders, and government regulators plan to tackle the issue?

Terry Medley, global director of corporate regulatory affairs for DuPont, put the challenge this way: "One of the pivotal questions is this: Based upon what we know about the bulk material, what of that knowledge can be appropriately extrapolated to nanomaterials? ESH research should bring together baseline data which will allow you to make valid assessments when you're looking at different materials."

The NNI–Chemical Industry Consultative Board for Advancing Nanotechnology (NNI–ChI CBAN) is an industry-related group helping to outline such a strategy. Their priorities for ESH research include the development of testing strategies, metrics for particle toxicity, and methodologies for exposure monitoring (please see www.chemicalvision2020.org/nanotechnology.html for details).

As leaders from industry and academe continue to define and prioritize ESH research needs, they're also pushing for increased funding. The federal budget for nanotech research has risen from $464 million in 2001 to $1.301 billion in 2006. Holliday and Krupp contended that a much larger portion of that total budget—10% instead of the current 4%—should be allocated for ESH research.



GILBERT WALKER

POLYSTYRENE NANOPARTICLES dynamically deposited into Poly (dimethylsiloxane) grooves.

A Nanoparticle in a Haystack

With ESH research expanding rapidly, scientists, regulators, and consumers will need help finding relevant information quickly and easily. To address this need, the CBAN group fostered the creation of a free, searchable database of ESH literature and data. That database is now up and running under the sponsorship of the International Council on Nanotechnology (ICON), a multiple-stakeholder group administered by Rice University and its Center for Biological and Environmental Nanotechnology (CBEN).

The ICON EHS database (http://icon.rice.edu/research.cfm) currently contains about 1,200 research papers from peer-reviewed scientific journals. "It's a very powerful way to search for just what you're looking for," said CBEN's Kristin Kulinowski.

Kulinowski added that ICON plans to expand the database project, making it more helpful to a wider audience. "Right now, you just get a list of papers, which in itself is very useful for researchers and government officials," she said. "The next step is to put some context on that and say, 'Based on this literature database, here's what we can say about carbon nanotube pulmonary toxicity or about whether quantum dots translocate through the skin.'"

Looking Ahead, Thinking Small

Many forces over the next decade will determine nanotechnology's path. Holliday and Krupp put it well: "With the right mix of voluntary corporate leadership, coordinated research, and informed regulation, we can reap the benefits of this promising technology while reducing the likelihood of unintended consequences."

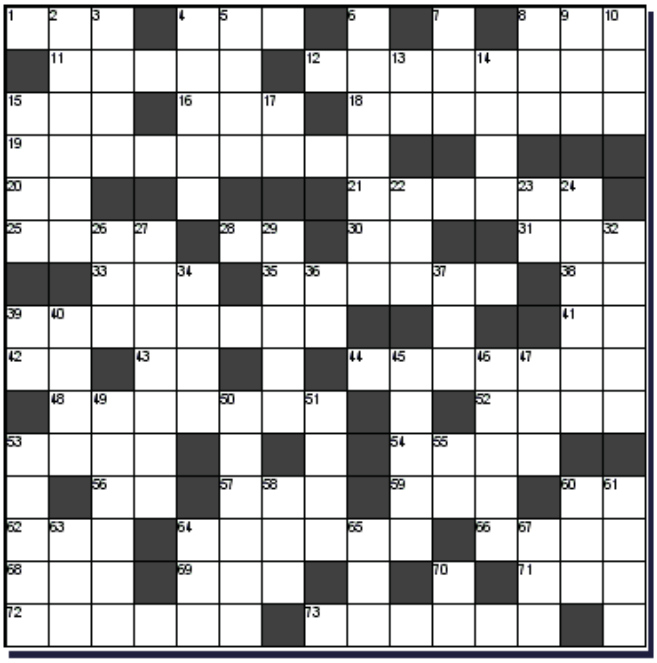
DuPont's Medley emphasized that industrial chemists will play an important role in the process. "Clearly, they are stakeholders with a lot to bring to the discussion, especially their expertise in the areas in which they work. Their engagement in this dialogue would be very useful."

So, fellow chemists, it's time to start thinking small. ⬢

Randy Wedin, Ph.D. (ACS '77), writes from Wayzata, MN. He launched a freelance writing business, Wedin Communications, in 1992. Before that, he spent a decade "inside the Beltway," working in Washington, DC, for the ACS and as a Congressional Science Fellow.

CROSSWORD

BY MARK S. LESNEY



THE LIGHT FANTASTIC

Solution to this puzzle can be found on page 47.

ACROSS

1. Summer melanin makeover
4. Closest 66 Across
8. Brewed drink
11. Nasty criminal
12. Divides into four
15. Alcoholic beverage
16. Mouth border
18. Bowmen
19. Emitted light or particles
20. Amplitude modulation or morning time, abbr.
21. Fear
25. "Spoke" of light
28. Milligram, for short
30. Not down
31. Typical working method, abbr.
33. Eye cover
35. Lax
38. Sumerian city
39. Wavelength, or an invisible blush?
41. Atomic weight 47.867; CAS Registry 7440-32-6
42. "Salty" metal, for short
43. Radiofrequency, for short
44. Like boro-silicate or soda-lime
48. Light "lumps"
52. Computer threat or earth eater
53. Goes with tear
54. Clutch
56. Positronium or afterthought, for short
57. Three-ish prefix
59. A coupling reaction like Glaser
60. "__ Mice and Men"
62. Small demon
64. "Ultra" color
66. Twinkling fusion in the sky
68. Fish eggs
69. Pertaining to frozen H_2O
71. Rock from which metal is extracted.
72. Concave or convex focusers
73. 570 nm wavelength color

DOWN

2. Combusting
3. Require
4. Type of 19 Across from 4 Across
5. For light, it's lumen
6. Light "leap"?
7. Electric gap-jump
8. Golf starting point
9. To fall asleep in a tanning booth, or to stare directly at the sun
10. Horse relative that brays
13. Third most abundant gas in air, briefly
14. God of lightning
15. Bedouin horse
17. 3.14159265...
22. "Outsider" prefix
23. Bone
24. Device that forwards data between computer networks
26. Hairy TV alien
27. Reflecting surfaces
29. 510 nm wavelength color
32. Refracts light
34. Crazy
36. First name of equine TV star
37. Health resort
39. Not out
40. Back of neck
45. Illuminating energy
46. Swings and _____
47. Wail
49. Occur
50. Science of 45 down
51. Ecological dirt
53. Go roundabout
55. Egyptian god of 4 across
58. "Light" Laureate, Glauber
60. Paddling instrument
61. Type of radical
63. Molecular modeling software
64. Compete
65. Biological light gatherer
67. Pull behind
70. Electroluminescence, for short

Dear Lab Rat,

ASK THE LAB RAT

Leo H. Sternbach's obituary in *C&EN* last year described the famous medicinal chemist as "a member of the 'two-legged rat' generation, when chemists tested drugs on themselves and recorded observed effects in lab notebooks." What do you know about this odd, bygone era in chemistry?

—A Curious Chemist

Dear Curious,

Don't be too quick with terms like "bygone" and "chemistry." Self-experimentation's longest and richest heritage may be in medicine. Despite the hazards, some researchers still become their own guinea pigs.

One 2003 editorial in the *Medical Journal of Australia* proclaimed self-experimentation "alive and well" after publishing a study in which the researcher infected himself with hookworm to study that parasitic disease. The Harvard School of Public Health held a symposium on self-experimentation in 2004. Microbiologist Bruce Marshall shared the 2005 Nobel Prize for Physiology or Medicine for research that involved infecting himself with the bacteria that cause stomach ulcers.

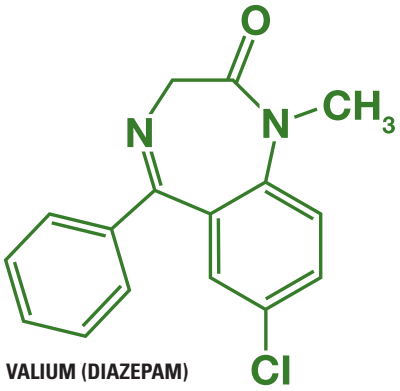
Leo Sternbach was continuing a long tradition in chemistry and medicine that may date to Sir Isaac Newton. Newton may have sampled concoctions from his dabbling in alchemy in the search for the "elixir of life." Tests on Newton's hair samples showed high concentrations of arsenic, mercury, gold, and lead—compounds used by alchemists.

The public's image of self-experimentation may involve fiction and mad scientists.

Remember Dr. Henry Jekyll, who turned into the murderous alter ego Mr. Hyde after gulping that experimental potion? How about Dr. Kurt Connors, the Spider Man villain who lost an arm in the war and took reptilian DNA to grow it back? He turned into The Lizard, an abominable creature half reptile and half human.

In reality, however, self-experimentation has played a role in major advances in modern medicine. German physician Werner Forssmann shared the 1956 Nobel medicine prize for inventing cardiac catheterization, the mainstay for diagnosing heart disease. Forssmann began in that work in the 1920s by threading a rubber tube through a vein and straight into his own heart. Jesse W. Lazear was among several scientists who in 1900 allowed infected mosquitoes to feed on their own blood to prove that those insects transmitted yellow fever. In the 1980s, French researcher Daniel Zagury tried to demonstrate the safety of an experimental AIDS vaccine by injecting it into his own arm.

Working at F. Hoffmann-La Roche Ltd., in Nutley, NJ, Sternbach in 1957 took doses of a compound that became the tranquilizer Librium, the first of the benzodiazepines. Two years later, he tweaked that molecule to invent Valium (diazepam), which was the first blockbuster drug—No. 1 seller in the United States from 1969–1982.



VALIUM (DIAZEPAM)

One good starting point for more fascinating accounts is Lawrence K. Altman's book, *Who Goes First: The Story of Self-Experimentation in Medicine.* Altman noted that self-experimentation became so popular at one university in the United States during the 1950s that some began calling it the "Kamikaze School of Medicine."

Most self-experimentation took place before the era of institutional review boards (IRBs), which now approve research involving human subjects. The heyday also occurred in an era when many individuals were less aware of health and safety risks and the importance of following safe procedures.

IRBs frown on letting researchers become guinea pigs because of concerns about the risks, lack of objectivity when researchers become experimental subjects, and other factors.

That concern goes ballistic when the research protocol calls for participation by both principal investigator and other lab members. IRBs always worry about possible coercion and undue influence. Are those lab technicians, grad students, and postdocs participating voluntarily, or because they fear retribution or want to curry the boss' favor?

Self-experimentation may have been regarded as heroic in the past, and earned Nobels. Without IRB approval today, however, it would be considered reckless and might get the human guinea pig kicked right out of the lab or dismissed from a job.

—*A.K.A. Muridae*

American Chemical Society

P.O. Box 82229, Columbus, OH 43202-2229

2006 MEMBERSHIP APPLICATION

❑ **YES,** I accept your invitation. Upon approval, please activate my ACS Membership including my subscription to *Chemical & Engineering News* (print and online). Also, sign me up for one year of free Division membership.

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Last Name _____ First Name _____ Middle Initial _____

Mailing address for delivery of *C&EN* and membership material. ❑ Home ❑ Work

(Please provide your full street address. This will enable us to ensure you receive your material in a timely manner.)

Company/University Name _____

Street Address _____

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Fax # _____ (Area Code) E-mail _____

For more information:
CALL (800) 333-9511 or (614) 447-3776
FAX (614) 447-3891
E-MAIL service@acs.org
WEB chemistry.org/joinACStoday

IMPORTANT NOTE: You must complete the entire application. Please do not leave out information. Incomplete information will slow down your admissions process.

ACADEMIC TRAINING (required)

Name of College or University (Including current enrollment)	City and State/Country	Curriculum Major	Title of Degree(s) Received or Expected A.S., B.S., M.S., Ph.D.	Month/Year Degree Received or Expected

PROFESSIONAL EXPERIENCE (required)

_____
Job Title

_____
Employer

_____
Employer City/State/Country/Zip/Postal Code

_____
Inclusive Dates/Employment (Mo/Yr)

_____
% of Time Spent on Chemical Work

_____
Work Functions

DEMOGRAPHIC INFORMATION (optional)

We ask you to provide the following *voluntary* information. The American Chemical Society is eager to support programs that benefit underrepresented groups in the chemical sciences, and your responses are helpful to these efforts (and to *all* facets of our services to *all* of our members). Individual responses are held in strictest confidence and have no bearing on consideration for membership.

Racial-ethnic origin (please check one only):

❑ White (Caucasian)
❑ Black or African Descent
❑ Hispanic
❑ Asian
❑ American Indian or Alaskan Native
❑ Native Hawaiian or Pacific Islander
❑ Other

Date of Birth_____ Sex: ❑ F ❑ M

MEMBER CATEGORIES

Regular Member: A person who has a bachelor's degree in a chemical science from an ACS-approved program; a bachelor's degree in a chemical science from a non-ACS-approved program and three years work experience; an earned doctorate or masters degree in a chemical science; a full certification, licensure or other qualification as a pre-college teacher of a chemical science and three years employment as a teacher of a chemical science; or less formal training than indicated above but having significant achievement in a chemical science, may become a full member.

Associate Member: Individuals may be placed in this membership category if they have not yet met the requirements for full Society membership.

Student Member: A person who is a graduate student, majoring in a chemical science or a related academic discipline, shall be entitled to a discount of one-half of the membership dues for full-time graduate work.

New Graduates: A person graduating with a bachelor's degree in a chemical science may apply for membership within one year from the date of graduation to receive a discount of one-half of the membership dues.

Non-Scientist/Society Affiliate: A person who is not eligible to become a member of the Society but whose major vocational effort is directly concerned with the practice of a chemical science may become an Affiliate of the Society at a rate of three-quarters of the membership dues.

Husband/Wife Dues: If you are the spouse of a member receiving *Chemical & Engineering News*, you may deduct $34.99 of your dues allotted for *C&EN*. Indicate this deduction in the Payment portion of your application.

Your membership will begin from the date your membership application is processed and will end one year later. This will be your anniversary date.

FOR OFFICE USE ONLY

MG BC _____ HDL _____ ASD _____
MJR _____ MED _____ PNI 3565K ___
DEL _____ TEC _____

THIS SPACE FOR USE OF ADMISSIONS COMMITTEE

LOCAL SECTION/DIVISION COMMISSION CLAIM

O6APPS

AMERICAN CHEMICAL SOCIETY DIVISIONS

The first selection is free for first-time members; additional selections will be billed.

My free division selection is_____.

I understand I may also join additional divisions and be billed along with my membership dues. (Check additional selections below.)

- ❑ Agricultural and Food Chemistry
- ❑ Agrochemicals
- ❑ Analytical Chemistry
- ❑ Biochemical Technology
- ❑ Biological Chemistry
- ❑ Business Development and Management
- ❑ Carbohydrate Chemistry
- ❑ Cellulose and Renewable Materials
- ❑ Chemical Education*
- ❑ Chemical Health and Safety
- ❑ Chemical Information
- ❑ Chemical Technicians
- ❑ Chemical Toxicology
- ❑ Chemistry and the Law
- ❑ Colloid and Surface Chemistry
- ❑ Computers in Chemistry
- ❑ Environmental Chemistry
- ❑ Fluorine Chemistry
- ❑ Fuel Chemistry
- ❑ Geochemistry
- ❑ The History of Chemistry
- ❑ Industrial and Engineering Chemistry
- ❑ Inorganic Chemistry
- ❑ Medicinal Chemistry
- ❑ Nuclear Chemistry and Technology
- ❑ Organic Chemistry
- ❑ Petroleum Chemistry
- ❑ Physical Chemistry
- ❑ Polymer Chemistry
- ❑ Polymeric Materials: Science and Engineering
- ❑ Professional Relations
- ❑ Rubber Division
- ❑ Small Chemical Businesses

**Journal of Chemical Education* is an additional cost.

PROFESSIONAL INTERESTS

Which category best describes the Field/Discipline in which you work? (please check only one)

- ❑ (10) Aerospace/Transportation
- ❑ (R) Agriculture & Food
- ❑ (G) Analytical
- ❑ (B) Biochemistry
- ❑ (Z) Biotechnology
- ❑ (F) Chemical Education
- ❑ (H) Chemical Information
- ❑ (2) Clinical/Diagnostic
- ❑ (I) Colloids & Surfaces
- ❑ (11) Combinatorial Chemistry
- ❑ (X) Computing/Molecular Modeling
- ❑ (7) Electronics/Semiconductors
- ❑ (4) Energy/Fuels
- ❑ (E) Environmental
- ❑ (L) Forensics
- ❑ (N) Geochemistry
- ❑ (12) Glass/Ceramics/Composites
- ❑ (Q) Health & Safety
- ❑ (P) Inorganic Chemistry
- ❑ (13) Lubricants/Oils
- ❑ (T) Marketing/Sales/Business
- ❑ (8) Materials
- ❑ (14) Metals/Metal Products
- ❑ (V) Nuclear
- ❑ (O) Organic Chemistry
- ❑ (15) Paint/Coatings
- ❑ (J) Personal Care/Cosmetics
- ❑ (D) Pharmaceutical/Medicinal
- ❑ (S) Physical
- ❑ (16) Polymers/Plastics
- ❑ (17) Pulp/Paper/Wood
- ❑ (6) Rubber
- ❑ (18) Soaps/Detergents/Cleaners
- ❑ (19) Textiles/Fiber
- ❑ (K) Toxicology
- ❑ (ZZ) Other (please specify)

_____

In the performance of my work, I recommend, specify, select, or purchase the following:

(check ALL that apply)

- ❑ Chemicals
- ❑ Instrumentation
- ❑ Software
- ❑ None of the Above

NOMINATION

We nominate this Applicant for membership in the American Chemical Society according to the Constitution and Bylaws.

1. ACS Member:

Denise L. Creech
Signature

Denise L. Creech
Printed Name

Director of Membership
Membership Division

2. ACS Member:

Joseph R Peterson
Signature

Joseph R. Peterson
Printed Name

Chair
Membership Affairs Committee

AGREEMENT

I attest to the accuracy of the information on this application. I agree to restrict for my own personal use all publications to which I subscribe at member rates. I understand that membership dues are payable annually unless my signed resignation is received by the Executive Director of the Society prior to the end of the 12-month period for which dues have been paid.

_____
Signature of Applicant

_____
Date

PAYMENT

Please check only one:

- ❑ Regular Member/Associate Member ($132/$190 outside North America.*)
- ❑ Non-Scientist/Society Affiliate ($99/$157 outside North America.*)
- ❑ Student Member ($66/$124 outside North America.*)
- ❑ Member Reinstatement – Membership #_____

* Includes the $58 postage fee for *C&EN* delivery outside North America. Dues include a small assessment for division and local section funding. U.S. members $34.99 allocated to *C&EN*. Non-U.S. members $34.99 plus postage allocated to *C&EN*.

Optional

- ❑ $34.99 deduction for Husband/Wife Dues
- ❑ IUPAC Affiliation $33.00 (U.S. members only). The International Union of Pure and Applied Chemistry is an internationally recognized authority on chemical nomenclature, terminology, symbols, atomic weights, and related topics. Membership includes a subscription to *Chemistry International* magazine.

Total amount to be paid $_____

❑ Check ❑ Visa ❑ MC ❑ Amex Exp. Date_____

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INSIDE ACS

For Members Only

Be a Voice for Science

In her January 6 President's Message published in *Chemical & Engineering News,* Ann Nalley (ACS '71) called for quadrupling the membership of the ACS Legislative Action Network (LAN). We encourage you to join the network by going to chemistry.org/takeaction.html.

LAN members receive e-mail alerts prior to key congressional decisions. These alerts explore the issue's background, the potential effect it might have on the scientific enterprise, and the position ACS holds. By clicking on a web link provided in the alert, participants can access the ACS Legislative Action Center to review the issue further and send letters to their legislators within minutes. In addition, the monthly *Capitol Connection* e-mail newsletter keeps members up-to-date about decisions being made on Capitol Hill and in the White House.

The more voices there are advocating for chemistry, the more informed legislators will be before enacting legislation. ⬢

40 Years Strong

ACS INSURANCE PLANS

ACS Member Benefit: Supplemental Retirement Plan

The ACS Supplemental Retirement Plan is one of many unique benefits that ACS offers its members. Members, Society Affiliates, their spouses, and certain family members may establish IRAs (Traditional or Roth) and/or Non-Qualified Tax-Deferred Annuities.

This plan is underwritten by Lincoln National Life Insurance Company, an industry leader with 100 years of experience, which offers expertise and unquestioned reliability. To support the maturation of fixed interest rate products, Lincoln National Life generally invests in intermediate-term fixed income products for periods of 5–10 years. This policy allows for a turnover in the portfolio to accept changing interest rates while maintaining the level of consistency that is so important to participant stability.

The ACS Supplemental Retirement Plan continues to offer a competitive interest rate on new contributions and comprises many unparalleled features. They include: the ability to withdraw up to 50% of accumulated interest earnings once per year without a surrender charge; an additional .10% in interest for 2006 credited for lump sum contributions of $20,000+ per participant; surrender charges not being assessed if the Participant remains in the plan for ten years or if the Participant is 59 ½ and retired, disabled, or deceased (whichever comes first); and automatic distributions that may be established on a quarterly, semiannual, and annual basis.

Sound financial plans require research and a willingness to change the plan based on life changes. Most employers offer some form of retirement plan, but the responsibility falls on employees to estimate their financial needs and to plan to meet them.

For more information, contact IPC: Plan.Support@IPC-VA.com or 1-800-368-3515. ⬢

Our 2006 Member-Get-A-Member Campaign kicked off in February! We are asking for your help again this year!

This year's campaign will offer ACS members a brand new Periodic Table of the Elements throw for the FIRST new eligible member* each of you recruits. (The 2006 throw will have new colors and the latest elements added. Please allow 6–8 weeks for delivery.)

BUT… we have another gift to offer you as well.

When you recruit more than one new eligible member, you will receive another NEW gift. We'll be sending you a package with all the details, but in the meantime you can start recruiting by going to **chemistry.org/membership/mgm.html**.

**In order to qualify, your nominees must be eligible for membership. You can also nominate former members who left the Society in 2004 or before.*

Just for ACS Members!

New Low-Cost Mortgages from MLN

ACS has joined together with Mortgage Lenders Network (MLN) to offer you a convenient and low-cost program for mortgage financing. MLN, one of the country's premier lending institutions, has been helping families reach their financial goals since 1996. Whether you plan to purchase a new home, vacation home, or investment property, or simply to refinance, this new ACS member benefit offers competitive rates. You'll also enjoy zero lender, broker, and origination fees and reduced third-party closing costs. In addition, as an ACS member, you can expect superior customer service from your MLN representative.

The ACS/MLN program offers innovative solutions to mortgage lending, such as the new 40-year fixed rate. There are mortgage programs for everyone, even those with a less-than-perfect credit history. ACS members can call for details at 1-800-695-9391. To get valuable information about purchasing a home, to learn more about the benefits of refinancing, or to find easy-to-use mortgage payment calculators, please visit the ACS/MLN program website at www.mlnusa.com/map/americanchem.

Financing your home is one of the largest financial decisions you'll ever make. Put the resources that MLN offers to ACS members to work for you! ⬢

INSIDE ACS

Nucleus
News from the Headquarters

2005 Nomination Campaign Winner—Nurtay Urdabayev

A graduate student at Bowling Green University, Nurtay Urdabayev (ACS '04) won the American Chemical Society's 2005 Nomination Campaign. Urdabayev won his prize by submitting the most names of individuals who became new members of the American Chemical Society. As the winner, he will receive a trip to the 232nd National Meeting in San Francisco, CA, in September 2006.

Born and raised in Shymkent, Kazakhstan, Urdabayev says that while he was in the eighth or ninth grade, he read a Russian translation of Isaac Asimov's *World of Carbon.* Commented Urdabayev, "This event predetermined my career interests and changed my world."

Urdabayev is currently working toward his Ph.D. at the Center for Photochemical Sciences at Bowling Green State University, Bowling Green, OH. In the meantime, he has accepted a job offer from Surtec, Inc., in Valparaiso, IN.

Congratulations and Good Luck to Nurtay Urdabayev, our 2005 Nomination Winner! ⬢

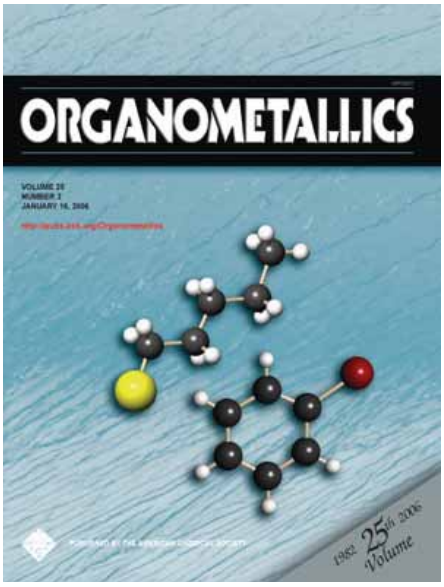
NURTAY URDABAYEV (ACS '04), winner of the 2005 Nomination Campaign

Dietmar Seyferth—25 Years of *Organometallics*

In 2006, ***Organometallics,*** among the most-cited journals in the field of inorganic and nuclear chemistry, celebrates its 25th volume of publishing state-of-the-art research in one of the most active fields for organometallic, inorganic, organic, and materials chemists.

Editor-in-Chief Dietmar Seyferth (ACS '51) has been at the helm of the journal through all 25 years of publication, spanning more than 400 issues and 100,000 published pages. From the launch in 1982 to the introduction of online publication in 1996, he has commanded ***Organometallics*** with vision and foresight.

With the first issue in 1982 boasting such notable authors as Richard R. Schrock (ACS '75), Roald Hoffmann (ACS '63), Barry M. Trost (ACS '66), George M. Whitesides (ACS '60), Charles P. Casey (ACS '62), and Dietmar Seyferth himself, to name a few, the significance of ***Organometallics*** was instantly established. That significance was highlighted on October 5, 2005, when Yves Chauvin, Robert H. Grubbs (ACS '64), and Richard R. Schrock were named the 2005 Nobel Prize in Chemistry recipients for their work on a carbon–carbon multiple bond metathesis that has gained great importance in organic and polymer synthesis. The award speaks highly of the field of organometallic chemistry and the journal in particular, as all three recipients have published research in ***Organometallics,*** with Richard R. Schrock serving as a founding Associate Editor of the journal and Robert H. Grubbs also serving as a member of the journal's advisory board.



ACS Publications extends its congratulations to Dr. Seyferth on the occasion of the journal's 25th Anniversary. Please visit the ***Organometallics*** homepage at http://pubs.acs.org/organometallics throughout 2006 for more information and to view the most-accessed articles published in the journal.

Organometallics is joined by a number of ACS Journals also marking significant milestones in 2006:

Journal of Chemical Theory and Computation—completed its first volume in 2005

Nano Letters & Crystal Growth and Design—both completed their fifth volumes in 2005

Journal of Proteome Research—now publishing its fifth volume

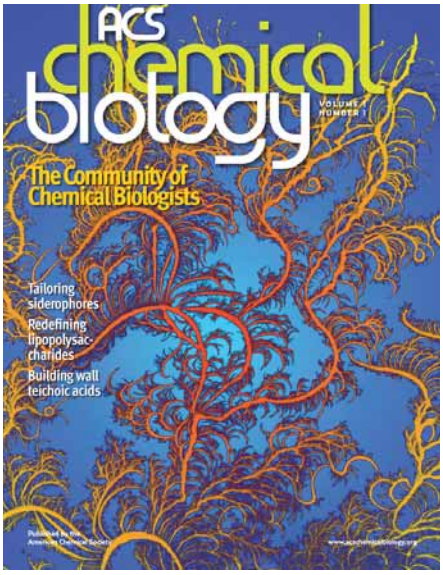
Organic Process Research & Development—now publishing its tenth volume

Journal of Physical Chemistry A & B—tenth anniversary (110 years total for the ***Journal of Physical Chemistry***)

Energy & Fuels—now publishing its twentieth volume

Environmental Science &Technology—now publishing its fortieth volume

Journal of Chemical & Engineering Data—completed its fiftieth volume in 2005



2006 Marks the Launch of *ACS Chemical Biology*

The American Chemical Society has launched its newest peer-reviewed publication, *ACS Chemical Biology.* Led by Editor-in-Chief Laura L. Kiessling (ACS '82), Ph.D., professor of chemistry and biochemistry at the University of Wisconsin–Madison, the journal provides an international forum for biologists and chemists working together to understand cellular processes.

"Education, research, and discovery at the interface of the traditional disciplines of chemistry and biology is fast becoming a mainstay of science," says Michael Marletta (ACS '75), Ph.D., professor of chemistry at the University of California, Berkeley, and one of seven founding members of the journal's board of editors. "Success will depend on continual efforts to blur those traditional boundaries. *ACS Chemical Biology* will play a prominent role in this endeavor by creating a forum for the large and diverse chemical audience within the ACS to engage in a substantive way with the exciting biological community."

ACS Chemical Biology, published monthly, offers readers not only peer-reviewed research findings, but also the latest viewpoints, commentaries, and highlights from the field. The journal uses these features to foster an environment that encourages communication and collaboration among researchers across the full gamut of subdisciplines in chemistry and biology.

"I see *ACS Chemical Biology* as a bold new model for the way biologists and chemists will look to collaborate with their peers in the future," says Executive Editor Evelyn Jabri (ACS '98), Ph.D., former senior editor with *Nature Structural & Molecular Biology.* "The journal provides a broad range of print and web tools for our colleagues to stay current, informed, and better equipped to do their own important research. As researchers in chemical biology ourselves, the board of editors and I are committed to leveraging *ACS Chemical Biology* in every way we can to meet the needs of young and established members of our research community and disseminate important findings as broadly as possible to advance the field."

Jabri and Managing Editor Sarah B. Tegen (ACS '03), Ph.D., former recruiting editor for *Proceedings of the National Academy of Sciences,* have worked together to develop *ACS Chemical Biology's* new website. The online forum, www.acschemicalbiology.org, offers interactive community features that are updated on a weekly basis and are free and open to all scientists, whether or not they subscribe to the journal or are members of ACS. These include "Ask the Expert," where questions are fielded by scientific experts to provide readers with new insights and perspectives, and a "Wiki" discussion forum, designed to stimulate communication among members of the chemical biology community.

In addition to Kiessling and Marletta, the journal's board of editors includes an international group of chemists and biologists known for their research strengths as well as their ability to communicate with a broad spectrum of scientists: Kai Johnsson (ACS '95), École Polytechnique Fédérale de Lausanne; Anna K. Mapp (ACS '92), University of Michigan, Ann Arbor; Peter H. Seeberger (ACS '91), Eidgenössische Technische Hochschule; James Williamson (ACS '90), The Scripps Research Institute; and Jennifer Doudna (ACS '98), University of California, Berkeley, and Howard Hughes Medical Institute. A list of editorial advisory board members can be found on the journal's website, www.acschemicalbiology.org.

INSIDE ACS

Catalyst Opportunities for You

AEI Academic Employment Initiative

Will You Be Starting a Faculty Job Search Next Year?

Plan to present an ACS Academic Employment Initiative (AEI) poster at Sci-Mix on Monday evening, September 11, at the 232nd ACS National Meeting in San Francisco. Faculty recruiters from many colleges and universities will be there to meet poster presenters. Show a poster and have job interviews at the same time. If you are a faculty member, please urge graduate students and postdoctoral fellows who are interested in academic careers to take advantage of this opportunity. Also, if you are in a department that will be hiring new faculty next year, please take advantage of this means of meeting several candidates in this relatively relaxed and informal setting.

The deadline for submission of AEI posters is **May 5.** To submit a poster abstract, please go to http://oasys.acs.org/oasys.htm. For more information about the Academic Employment Initiative or the Sci-Mix poster session, please go to chemistry.org/aei.html or write to GradEd@acs.org. ⬢

WEBSTER SANTOS (ACS '99) explains how his studies combine chemical synthesis and RNA biochemistry. (Photo taken at the AEI poster session, Fall 2005 ACS National Meeting)

ACS Regional Meetings: Research, Opportunity, Networking, and Fun!

A beer fest in Michigan! A tour of Frank Lloyd Wright's S.C. Johnson building in Wisconsin, a tour of a chocolate plant in Hershey, and a sure bet the programming is a winner in Reno! There is still time to register for the spring meetings at the advance rate in these regions: Central (Frankenmuth, MI); Great Lakes (Milwaukee, WI); Middle Atlantic (Hershey, PA); and Northwest (Reno, NV).

The fall meetings are accepting abstracts and advance registration online now as well. These gatherings will take place in the following regions: Northeast (Binghamton, NY); Rocky Mountain (Tucson, AZ); Southwest (Houston, TX); Midwest (Quincy, IL); and Southeastern (Augusta, GA).

All papers accepted for regional meetings become part of the CAS database.

Please visit chemistry.org/meetings/regional/ to link to the websites of all the 2006 meetings and get the details about the exciting programming offered by each. There are 10 meetings this year—every region is participating! There has to be one near you! ⬢

Chemists Celebrate Earth Day

April 22 and Chemists Celebrate Earth Day (CCED) provide an opportunity to reach out to your community this spring with positive messages about chemistry! The CCED 2006 topic is "Dig It!" and local sections and student affiliates will be celebrating in a variety of ways.

All local sections and student affiliates are encouraged to participate in the unifying event, "Plant It for the Planet." For grades K–12, there is an illustrated haiku contest, and college students are invited to compete in a video contest. Hands-on activities (in English and Spanish), book and electronic resource lists, contest guidelines, and safety guidelines are also available from the website (please see below).

Details are posted on the CCED website, chemistry.org/earthday. Promotional items for CCED events are available through the ACS Online Store. For additional information, please contact the ACS Office of Community Activities at 800-227-5558, ext. 4458, or at earthday@acs.org.

Revising the ACS guidelines for two-year and four-year programs: A community dialog of issues and opportunities

Most ACS members are familiar with the ACS Guidelines for chemistry programs in four-year colleges and universities. On behalf of ACS, the Committee on Professional Training (CPT) approves departments or programs that meet the guidelines, and chairs certify those students who have met the curricular guidelines of the approved programs.

Many members remain unaware of another resource, designed specifically for two-year programs by the Society Committee on Education (SOCED). Although the *Guidelines for Chemistry Programs in Two-Year Colleges* are not used in any formal ACS approval process, they do serve as a guide for institutional self-studies and program reviews.

The *Guidelines for Chemistry Programs in Two-Year Colleges* are focused on transfer programs and should be revised to reflect the changes being made to ACS Guidelines for four-year programs. SOCED and CPT have begun a dialogue about the respective revisions and ways in which two- and four-year programs can work together to enhance undergraduate education in chemistry. You are invited to contribute to this discussion during the upcoming interactive symposium titled "Revising the ACS guidelines for two-year and four-year programs: A community dialog of issues and opportunities" at the upcoming 19th Biennial Conference on Chemical Education, which will take place at Purdue University, IN, July 30–August 3, 2006. For more information about the program and speakers, please go to chemistry.org/education/2year.html and select ACS Guidelines for Chemistry Programs at Two-Year Colleges. ⬢

National Chemistry Week: "Your Home—It's All Built on Chemistry"

Each year the American Chemical Society's National Chemistry Week (NCW) campaign reaches millions of people with positive messages about the contributions of chemistry to their daily lives. It is the one time during the year that chemists unite with the common goal of spreading the word that chemistry is good for our economy, our health, and our well-being. The celebration dates for 2006 are October 22–28, and the theme is "Your Home—It's All Built on Chemistry."

Some ways that you can contribute to the NCW campaign are: helping at an event planned by your NCW coordinator; performing chemical demonstrations at a neighborhood school; conducting hands-on activities with children at museums, malls, or libraries; or writing articles or letters to the editor of your local paper. Please contact The Office of Community Activities (800-227-5558 ext. 6097, ncw@acs.org) or visit chemistry.org/ncw to learn more.

Please join the celebration! ⬢

Mark Your Calendar!

ACS National Meetings

232nd, Fall, Sept 10–14, 2006
San Francisco, CA

233rd, Spring, March 25–29, 2007
Chicago, IL

234th, Fall, Aug 19–23, 2007
Boston, MA

235th, Spring, April 6–10, 2008
New Orleans, LA

2006 ProSpectives Conferences

Process Crystallization in the Pharmaceutical and Chemical Industries
April 25–27 • Philadelphia, PA

Discovery & Selection of Successful Drug Candidates
May 7–10 • Cambridge, MA

Applying Mechanisms of Chemical Toxicity to Predict Drug Safety
June 4–6 • Washington, DC

Successful Protein Therapeutics: The Interconnection of Formulation, Process Development & Manufacturing
July 23–26 • San Diego, CA

Pharmacokinetics & Pharmacodynamics for Medicinal Chemists: Achieving Therapeutic Efficacy
Aug 20–22 • Boston, MA

2006 ACS Regional Meetings

37th Central Regional Meeting (CRM)
May 16–20 • Frankenmuth, MI
www.crm2006.org/

37th Great Lakes Regional Meeting (GLRM)
May 31–June 2 • Milwaukee, WI
http://alchemy.chem.uwm.edu/GLRM06/

38th Middle Atlantic Regional Meeting (MARM)
June 4–7 • Hershey, PA
www.marm2006.org

61st Northwest Regional Meeting (NORM)
June 25–28 • Reno, NV
www.chem.unr.edu/norm06/

34th Northeast Regional Meeting (NERM)
Oct 5–7 • Binghamton, NY
www.nerm2006.org/

19th Rocky Mountain Regional Meeting (RMRM)
Oct 14–18 • Tucson, AR
www.rmacs2006.arizona.edu

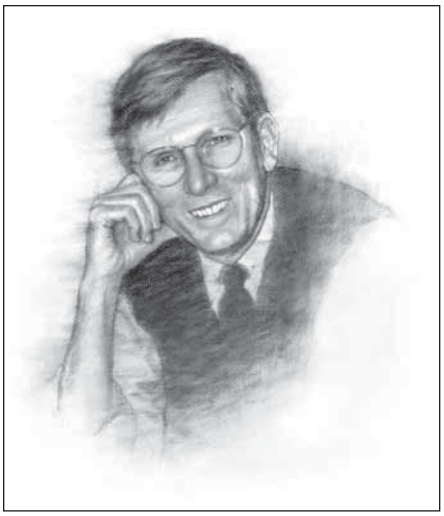
41st Midwest Regional Meeting (MWRM)
Oct 25–27 • Quincy, IL
http://membership.acs.org/m/mwrm2006/

61st Southwest Regional Meeting (SWRM)
Oct 19–22 • Houston, TX
www.chem.uh.edu/swrm06/

58th Southeast Regional Meeting (SERMACS)
Nov 1–4 • Augusta, GA
www.sermacs2006.org

For more information, call 800–227–5558, toll-free, or e-mail help@acs.org.

BY JAMES F. RYAN



When Science Was Seen

Sorcery, not aerospace technology, drew crowds to the National Air and Space Museum last holiday season. It may have been one symptom of a growing public inability to fathom modern science's complexities, let alone sense the wonder that enthralled past generations.

Among the advantages for some employees of the American Chemical Society is that the headquarters location is Washington, DC. About half of us work here in the nation's capital, and when relatives descend, there are any number of places to visit for diversion. So it was that I led a family outing to the National Air and Space Museum this past December. This building is of course an icon to science and engineering, attempting to showcase the accomplishments of American (and it must be said, some international) technology in aviation and space exploration.

There is the *Spirit of Saint Louis* hanging from the ceiling. Beside it is *Apollo 11,* the spacecraft of Armstrong, Aldrin, and Collins on their first trip to the lunar surface. There are mock-ups of the Wright brothers' bicycle workshop from Dayton Ohio, John Glenn's Gemini space capsule, and Skylab, the joint American–Russian project that predates our current International Space Station.

So given all this, it takes a certain sense of irony to say that we were there to see *Harry Potter and the Goblet of Fire* in the museum's Imax theatre. It was not wingspan and spacecraft we sought, but rather owl and broomstick. Nevertheless, given that to be assured of good seats, we had to arrive more than an hour early for our visual trip to Hogwarts, there was plenty of time to look around.

Faded Memories

I had last seen these displays some 15 years ago, again taking out-of-town relatives on a family outing. This 2005 night, many of the craft, air and space, were there just as they had always been. Walking into the lobby and looking up still brought a sense of wonder…could Charles Lindbergh really have flown across the ocean in such a rickety thing? What was Glenn thinking as he rode on the top of a huge Roman candle? However, some of the vehicles appeared dusty. Others had signage that looked faded, and in the dim distance, there were displays that seemed as if they hadn't been moved in years, almost frozen in time and place. For that moment, it all seemed just a little sad, like going back to your childhood home and seeing it in disrepair.

To me, the reason for this sentiment is because Air and Space, of all the museums on the national mall, is the one that always had exhibits most relevant to the current state of scientific skill. The science and technology displayed seemed to be focused on problems you could actually see and understand, or at least thought you could. As a kid, when not working with my Gilbert chemistry set, I read the space hero novels about Tom Swift and later came to appreciate the futuristic insight of Isaac Asimov.

I could look up at the moon and see, almost viscerally feel, where President Kennedy was challenging us to go and to return safely. Science seemed ecumenical, understandable to all if they tried, and attractive as a career in the service of the world. Richard Feynman once described how he got interested in science, in his case physics, by soldering together ham radio sets with large vacuum tubes and in so doing, began to understand the concepts of electromagnetic radiation. It seems all gone now. I can't see anyone today soldering together their own iPod.

Science's New Face

Science challenges today seem to be either overwhelming or ineffable, evading ready understanding. We have huge problems such as energy conservation and global warming. We have virus pandemic problems that require a biochemistry graduate to even begin to grasp, much less solve. None of these problems seem to be in our museums or subject to a call-to-arms from our leaders.

Even worse, many people find science threatening. Drugs are looked at only secondarily as a means of saving lives and protecting health. More often, they are seen as a means of profit and for their ability to lure Wall Street into higher valuations of pharmaceutical stocks. Agricultural crops such as corn and soybeans with added genes that promote resistance to pesticides are called Frankenfoods. Problems seem daunting and their adverse consequences unavoidable. We seem to be just waiting for avian flu to wipe out half the human population.

Two things seem to be missing now. First is the feeling that an average person can understand science problems and have influence on them. Most people I talk to do not see science in any kind of everyday setting. News programs report on science, if at all, only in terms of breakthroughs and eureka discoveries, not in terms of theory, hypothesis, experiment, and measurement. The second missing item is recognition that science is fun. Just knowing how things work is incredibly interesting, whether the item in question is a rocket or a mass spectrometer.

Science Facing the Future

We have to find a way to make today's science as exciting and visible as it was to us in years past. Otherwise science will be seen as indistinguishable from sorcery, and it won't be just as a monetary endeavor that museums show Harry Potter films. Rather it will be because the visitors think that somehow films such as these represent science, leaving everyone with expectations that are confused, neither reasonable nor achievable We can, indeed we must, do better if we are to pass on to a younger generation the sense of wonder that we felt when we decided on science as a career. ⬢

Jim Ryan's (ACS '67) career included seven years serving as editor of Today's Chemist at Work *magazine, where his commentary was must reading for chemists in industry. His new column appears regularly in* Chemistry. *Jim can be reached at j_ryan@acs.org.*

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www.cas.org

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Insurance
chemistry.org/insurance

CEN-chemjobs
cen.chemjobs.org

Minority Affairs
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Younger Chemists Committee
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We hope you enjoyed reading this issue of *Chemistry*.

Another great benefit of your membership in the American Chemical Society

In case you missed Jim Ryan's For Closers, click here.