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SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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sweet dreams, long life

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Columbia Disaster

Why did the space shuttle burn up?

LIFTOFF AND LOSS The space shuttle Columbia taking off on Jan. 16. A mishap 81 seconds after launch may have doomed the craft, which broke apart (inset) 16 minutes before it was scheduled to land on Feb. 1. Columbia's final mission was one of the few devoted to science.

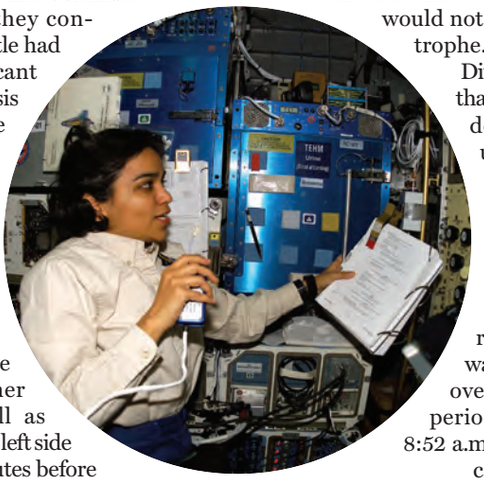
The space shuttle Columbia, which tore apart killing all seven of its crew on Feb. 1 just minutes before it was scheduled to land, may have been doomed since its liftoff. That's when an estimated 2.7-pound chunk of insulating foam, perhaps combined with ice, came loose from the main external fuel tank and struck the underside of the shuttle's left wing near the wheel well. The chunk was the largest piece of debris known to have struck a shuttle during launch.

Engineers first became aware of the mishap while watching a video of the liftoff on Jan. 17, the day after launch. After a weeklong analysis, while Columbia was still in orbit, they concluded that the shuttle had not suffered significant damage. That analysis focused mainly on the heat-resistant ceramic tiles that protect the shuttle during its fiery reentry through Earth's atmosphere.

But in light of a 40°F temperature spike in a left-side brake line and other equipment, as well as increased drag on the left side of the craft just minutes before the breakup, that assessment is now under scrutiny.

"We are completely redoing the analysis from scratch," said shuttle program manager Ron Dittemore of NASA's Johnson Space Center in Houston at a Feb. 4 press briefing. "We want to know if we made any erroneous assumptions."

Tiles have frequently come loose on the space shuttle fleet but have never caused a crash. On Columbia's maiden journey in April 1981, some 15 tiles were thought to have loosened when foam from a fuel tank struck just after liftoff. In that case, and on at least one similar occurrence on another shuttle, engineers correctly predicted that dislodged tiles would not lead to a catastrophe.



SCIENCE LEGACY Astronaut Kalpana Chawla recording data from an experiment in the SPACEHAB research module, on day 11 of the last Columbia mission.

Dittemore cautions that the loss of tiles, despite coming under early suspicion as the cause for the crash, may have nothing to do with the disaster. He notes that the relatively modest warming recorded over a 6-minute period beginning at 8:52 a.m. EST was small compared with the 2,500°F temperature that some parts of the shuttle's exterior endured, as expected, as the craft plunged through Earth's atmosphere at more than 18 times the speed of sound.

The data suggest "there's some other missing link that we don't have yet," Dittemore said Feb. 4. The problem may have originated elsewhere on the shuttle.

Mark Drela, an aerodynamics researcher at the Massachusetts Institute of Technology (MIT), still suspects that tile damage was the culprit. The small temperature increases that were recorded may simply reflect that "the temperature sensors may not have been in the most vulnerable place," he suggests. Reports that fragments were already falling from Columbia as it flew over California, several minutes before it broke apart over Texas, are consistent with the gradual intensifying of a problem that might have begun with a few tiles loosened or dislodged at liftoff. Drela suggests, "There wasn't one giant blowup but gradual [deterioration] over several minutes.

"It's like a domino effect," Drela says. "If one piece of tile falls off in a vulnerable spot during reentry, heat melts the underlying aluminum skin like a blowtorch and then adjacent pieces of tile fall off as heat penetrates from inside the structure."

Age also may have played a role in the demise of the 22-year-old Columbia, the oldest of the fleet of four shuttles. "It's like an aging car," Drela says. Even with constant upgrades and maintenance, he adds, "things are more likely to break down . . . . You can't overhaul every square millimeter of the shuttle."

In congressional testimony last year, Richard D. Blomberg, former chairman of the Aerospace Safety and Advisory Panel, which NASA created after the 1986 Challenger accident, put it this way: "As [shuttle] components and subsystems age

NASA; AP/WIDEWORLD; NASA

beyond their design lives, they may fail more often and with new and unanticipated failure modes."

Age need not be factor, contends Jeffrey A. Hamilton, an MIT astronomer and former NASA astronaut who has flown on five shuttle missions, including two on Columbia. With proper maintenance, many airplanes built in the 1960s are still flying safely, he notes.

NASA has been walking a fiscal tightrope for a decade, although President Bush's budget proposal released this week includes a boost for the agency's research and development (*see story on page 86*). Hamilton says that NASA hasn't cut corners on shuttle safety.

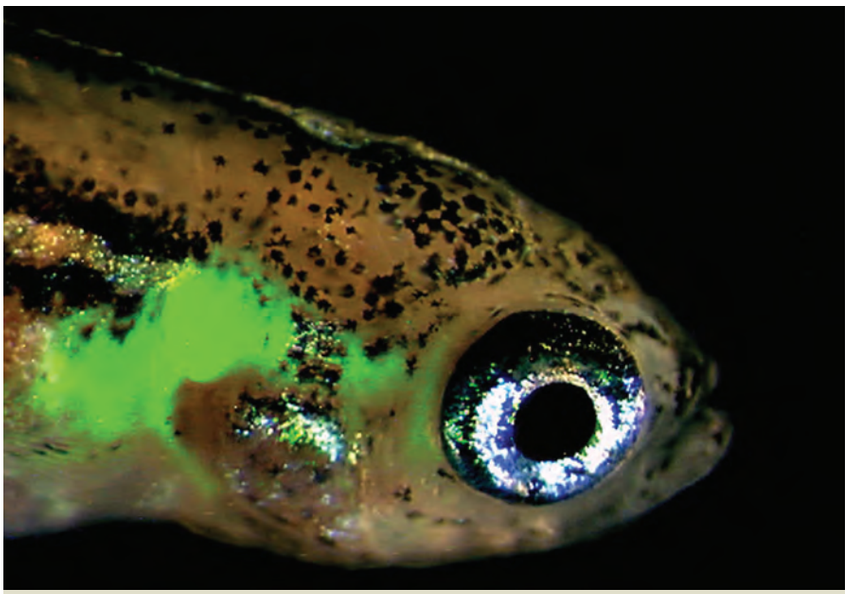
However, in 2001, NASA rejected a plan for a detachable shuttle cockpit that would be an emergency-escape vehicle, in part because it would be too costly.

The Aerospace Safety and Advisory Panel has become increasingly worried about NASA's ability to manage the space shuttle program safely. The panel's 2001 annual report to NASA contained "the strongest safety concerns that the panel has voiced in the 15 years I was involved with it," says Blomberg, who is no longer a panel member. Driving that concern, he noted during congressional testimony in 2002, are "unrealistically short planning horizons being used to make decisions about space shuttle flight-system improvements, the restoration of aging infrastructure, personnel-succession planning, and logistics."

Just as it did after the Challenger shuttle blew up, NASA has put a moratorium on all shuttle flights. The crew on the Earth-orbiting International Space Station now has enough supplies to last to the end of June, the agency says.

Columbia's final mission was one of the few shuttle missions devoted entirely to science. Experiments on board included observations of atmospheric ozone levels, the wind-driven redistribution of dust from deserts, the behavior of fireballs in microgravity, bacteria adjusting their respiration to conditions in space, and magnetic fields' influence on plant-root cells. The astronauts monitored their own physiological functions during rest and exercise to explore aspects of the cardiovascular system normally masked by gravity. The findings may help patients on Earth (*SN: 6/15/02, p. 376*).

Some of the data from these and other experiments were transmitted to Earth during Columbia's mission. They will serve as part of the legacy of the seven astronaut-scientists who were lost. —R. COWEN



J.P. KANKI

Catch of the day for cancer researchers

Glowing zebrafish, like this one, may provide insight into the spread of human leukemia and other cancers in which a gene called *MYC* promotes cell growth. Researchers fused the mouse version of *MYC* to a gene encoding a fluorescent-green protein and inserted the combination into zebrafish DNA. They injected this DNA into embryos to create lines of fish in which the gene is active in some immune cells. The resulting cancerous cells, which arise in the thymus and migrate initially to the gills and eyes, glow brightly in the transparent fish. A. Thomas Look of the Dana-Farber Cancer Institute in Boston and his colleagues, who describe their work in the Feb. 7 *Science*, plan to introduce mutations into such fish to identify genes that speed or slow the spread of *MYC*-driven cancer cells. —J. TRAVIS

Exonerated?

Foods' acrylamide risks appear low

A new Swedish analysis downplays the likelihood that people will develop cancer from eating foods naturally tainted with acrylamide, a building block of many plastics and an animal carcinogen.

Acrylamide made headlines last year when researchers reported that the compound routinely forms during high-temperature cooking, such as frying and baking, especially of potatoes, breads, and other starchy foods (*SN: 8/24/02, p. 120*). Four separate chemistry studies linked the creation of acrylamide to common flavor-enhancing reactions between certain amino acids and sugars (*SN: 10/5/02, p. 213*).

Researchers at the Karolinska Institute in Stockholm have now reanalyzed data from three other studies—ones involving patients with cancers in the large bowel, kidney, and bladder. When acrylamide has been consumed as part of the diet, "the areas where you'd first expect to see any [cancer] risk would be in these organs," notes study leader Lorelei A. Mucci, who holds a joint appointment at the Harvard School of Public Health in Boston.

Using detailed dietary histories collected from almost 1,000 cancer patients in Sweden and more than 500 age-matched Swedes without cancer, the researchers calculated the likely dietary intake of acrylamide for each participant. In the Jan. 28 *British Journal of Cancer*, Mucci's team reports finding no "excess risk, or any convincing trend, of cancer" among even those people who were heavy consumers of crisp breads, pan-fried potatoes, and other foods that typically show high acrylamide concentrations. "I don't think that the doses are going to be different in the United States," Mucci notes, despite different food preferences.

The acrylamide typically found in the human diet appears to be "effectively detoxified," the researchers conclude. However, because acrylamide exposure by inhalation and injection has caused neurological impairments and has been linked to various cancers in animals, Mucci cautions that "more research needs to be done."

Responses to the new study have been mixed. "We are cautiously optimistic about these findings," says Jeff Nedelman, spokesman for the Snack Foods Association in Alexandria, Va.

However, Michael F. Jacobson, executive

director of the Center for Science in the Public Interest in Washington, D.C., charges that estimates of exposure were based on data from too few foods and that the study size was probably too small "to find or disprove a link between acrylamide and cancer." As such, he finds the study by Mucci's team "no reassurance whatsoever that acrylamide is safe for humans." —J. RALOFF

Bad Sleepers Hurry Death

Snoozing soundly staves off the Big Sleep

For many people, a good night's sleep is rare. Surveys indicate that around one in three older adults, ages 55 and up, experiences chronic insomnia or other sleep disturbances. The news gets worse.

Among a group of healthy elderly people tracked for an average of 13 years, those who had difficulty falling or staying asleep died from natural causes at a much higher rate than those who slept well, according to a report in January/February *Psychosomatic Medicine*.

If the results hold up, researchers will need to examine whether medications and behavioral treatments for insomnia boost survival in the elderly, say study leader and psychologist Mary A. Dew of the University of Pittsburgh School of Medicine and her colleagues.

In an investigation going back to 1984, the researchers studied 186 elderly adults, most between 60 and 80 years old, who had never exhibited mental disorders, significant sleep disturbances, or any marked declines in thinking and memory. None took sleep-altering medications. As part of the study, each participant underwent brain wave monitoring during sleep for one or two nights in a sleep laboratory.

Between 4 and 19 years after entering the study, 66 volunteers had died, primarily from cancer, heart disease, and pneumonia. Of that number, 38 percent had taken longer than 30 minutes to fall asleep in the lab and 51 percent had lost substantial sleep due to nighttime awakenings. Among the surviving 120 participants, 19 percent and 31 percent, respectively, had displayed those sleep problems.

A less pronounced, but statistically notable, death-rate increase occurred for participants who had exhibited an unusually high or low percentage of rapid eye movement (REM) sleep.

The disparities in sleep-related problems between the group that died and the surviving group could not be explained by age, sex, or physical condition of volunteers upon entering the study, Dew and her colleagues report.

"[Sleep disturbances] are increasingly being implicated as predictors of mortality, especially in older adults," comments psychiatrist and sleep researcher Michael Irwin of the University of California, Los Angeles.

Sleep problems may hasten death in any of several ways. For instance, Irwin has reported associations between sleep disturbances and immune system impairments. Other data tie sleep disorders to an increased risk of dying from heart disease and to neurotransmitter disturbances that may contribute to brain disease.

It's also possible that sleep apnea, disorganized circadian rhythms, and undetected, early stages of progressive brain diseases contributed to deaths in her team's study, notes Dew.

The new findings shouldn't send people running to their physicians for sleeping-pill prescriptions, Irwin says. To sleep better, he first advises going to bed and waking up at regular times, exercising daily, and limiting alcohol use. —B. BOWER

Bt Cotton

Yields up in India; pests low in Arizona

The two cotton-growing centers could hardly differ more. But small farms in India and industrial fields in Arizona both provide case studies that show the bright side of a widespread genetically engineered crop.

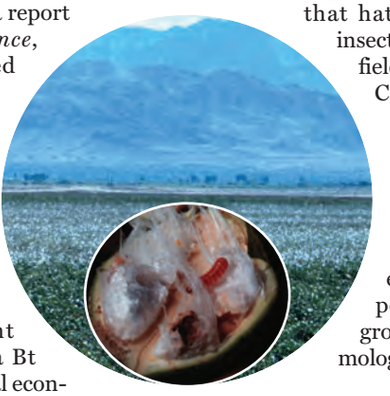
The crop, Bt cotton, has borrowed a toxin gene from the bacterium *Bacillus thuringiensis* to make its own pesticide. According to a report in the Feb. 7 *Science*, Bt cotton has raised yields some 80 percent on small farm plots in India compared with neighboring plots growing conventional cotton. It's the first time that tests have found a whopping yield improvement from switching to a Bt crop, says agricultural economist Matin Qaim of the University of Bonn in Germany. The same jump might also show up in other tropical and subtropical farming regions, say Qaim and coauthor David Zilberman of the University of California, Berkeley.

On the other side of the world, clusters of Arizona cotton fields with Bt plants on more than 60 percent of the acreage have managed to suppress the local populations of the dreaded pink bollworm, says entomologist Yves Carrière of the University of Arizona in Tucson. The analysis represents the first time that observers have documented such a drop, Carrière and his colleagues report in an upcoming *Proceedings of the National Academy of Sciences*.

In India, when a seed company in 2001 tested Bt cotton varieties, Qaim and Zilberman received funding from the German government's research arm to monitor the results. Standard pesticides are hard to get and expensive in India, so farmers typically lose much of their crops to insects. In this setting, the Bt cotton brought hefty increases in yields, says Qaim. In contrast, in the United States and China, Bt cotton overall has posted less than a 10 percent gain in yield over regular varieties.

Even with that small yield boost on Chinese farms, Bt cotton decreased use of pesticides and thus dramatically increased a typical farm's income in recent years, says Per Pinstrup-Andersen of Cornell University. "The public sector has to invest in research for the good of poor farmers—including genetic engineering," he says. "The thing that concerns me is that insects will develop resistance."

In Arizona, Carrière and his colleagues analyzed data on cotton varieties and pink bollworm infestations from 1991—5 years before the introduction of Bt cotton—until 2001. Their work was partially funded by a cotton-growers association. In regions with extensive plantings of Bt varieties, the researchers noted that bollworm populations the next spring started out at less than a sixth of what they had been with conventional cotton. Bt crops kill more than 90 percent of the bollworm larvae that hatch on them, so adult insects that meander into a Bt field "are wasting eggs," says Carrière.



T. DENNEHY

SUPPRESSED
Populations of pink bollworm (inset) shrink in regions with abundant Bt cotton.

There has been a long-standing debate in the entomological community about whether a high density of Bt crops could wallop pests hard enough to reduce local populations beyond one growing season, says entomologist Fred Gould of North Carolina State University at Raleigh. The Arizona work shows that this is possible, he notes.

Carrière cautions that success depends on avoiding pesticide resistance. Lab work has shown that pink bollworms already carry gene variants that in certain combinations can provide immunity. Arizona scientists monitor yearly fluctuations in the

prevalence of these variants in insects in the field but haven't observed resistant insects. Carrière says, "So far, so good." —S. MILIUS

Budget Boosts and Busts

R&D for Defense, NASA garner funding rise

The five-volume, 2,866-page budget proposal forwarded to Congress by President Bush on Feb. 3 contains a record-setting request for federal research and development. Together, NASA and the Department of Defense are slated to receive about 80 percent of the suggested increase in R&D funding. Other big winners in this year's budget include the National Science Foundation and the newly established Department of Homeland Security. Among budget losers are the Environmental Protection Agency and the Department of Commerce.

Of the $2.23 trillion in proposed federal expenditures planned for fiscal year (FY) 2004, which starts Oct. 1, nearly $123 billion would fund R&D. That's an increase of about $8 billion over last year's proposals, or just over 5 percent after accounting for the expected rate of inflation. John H. Marburger, the President's science adviser, says the new budget's research dollars reflect two main priorities: protecting people in the United States against the threat of terrorism and strengthening the economy. "There's a sharpened need to fund the highest priorities," he notes. "That's good for science."

However, says Sherwood Boehlert, chairman of the House of Representatives Committee on Science, "the administration's budget proposal for science and technology is disappointing, although perhaps unsurprising given the budgetary constraints . . . . Many science programs do not even keep up with inflation."

In dollar terms, the Defense Department wins big in the new budget: Its research and development programs capture $62.8 billion, a $5.3 billion boost over last year's proposals and a whopping 51 percent of next year's suggested total for R&D funding.

The Department of Health and Human Services, whose R&D budget goes almost entirely to the National Institutes of Health, stands to garner only a meager jump in funding from this year's budget. Although large in dollar terms, the agency's suggested $565 million increase tallies, after inflation, as a 0.6 percent improvement over last year. This marginal increase comes on the heels of an FY 2003 budget proposal in which R&D funding for NIH soared by 13.3 percent (*SN: 2/9/02, p. 85*).

As in last year's budget proposal, NIH's biodefense efforts would get a shot of fresh research dollars. Part of these funds is directed to studies on blocking the effects of botulism toxin, understanding pathogens likely to be used in bioterror attacks, and analyzing how the human immune system responds to dangerous microbes.

Many medical scientists are unhappy with the essentially flat overall budget for NIH. "The administration's proposed funding level . . . is highly inadequate and will decrease and slow progress in many areas of biomedical research," says Janet Shoemaker of the American Society for Microbiology in Washington, D.C.

In the new budget proposal, NASA snagged $938 million more than the President had asked Congress for last year. If approved, the space agency's R&D programs stand to grow by 7.7 percent. However, all of the President's budget proposals were assembled before the Feb. 1 disaster in which the space shuttle Columbia and its seven-person crew were lost while reentering Earth's atmosphere (*see page 83*).

"It's way too early to tell how the loss of Columbia will affect the R&D budget," says Sarah Keegan, a spokesperson at NASA headquarters in Washington, D.C.

The Department of Energy is slated for a $459 million increase, which includes increased funding—about $720 million over the next 5 years—for the FreedomFUEL program. That program will focus on developing the technologies and infrastructure needed to produce, store, and distribute hydrogen fuel for future vehicles and power plants.

The Department of Homeland Security (DHS) outpaced all other departments in proposed percentage increase for R&D dollars. The newest cabinet-level department in Washington, officially launched just last month, would get a $240 million, 29.6 percent inflation-adjusted boost over what was proposed last year for the 22 segments of other agencies that will be consolidated into DHS.

More than $900 million of the DHS R&D budget would fund projects to find better ways to combat terrorism. Another $2.3 billion would fund similar research within other departments of government.

Additional multiagency R&D efforts include nearly $1.75 billion for climate-change research and $847 million to fund nanotechnology studies.

The National Science Foundation was tapped to get just over $4 billion for its research and development projects next year, a $370 million, 8.4 percent increase over last year's budget proposal. A large chunk of the money will fund new research facilities, including a 1-cubic-kilometer neutrino detector embedded in the Antarctic ice sheet, a giant radiotelescope array in the

R&D Budget Proposal (in millions of dollars)*

AGENCY OR DEPARTMENT	FY 2002 ESTIMATE	FY 2003 PROPOSED	FY 2004 PROPOSED	PERCENT CHANGE† 2003–2004
Defense	49,409	57,498	62,753	7.6
NIH‡	22,581	26,524	27,056	0.5
NASA	9,611	10,071	11,009	7.7
Energy	8,056	8,076	8,535	4.2
NSF	3,557	3,692	4,062	8.4
Agriculture	2,112	1,911	1,943	0.2
Commerce	1,376	1,304	1,190	–10.0
Homeland Security§	266	761	1,001	29.6
Interior	623	575	633	8.5
EPA	416	627	556	–12.6
Other	4,022	3,963	4,000	–0.5
Total	102,029	115,002	122,738	5.2

*Adapted from Office of Management and Budget and National Institutes of Health data; figures reflect rounding.

†Adjusted for 1.46 percent expected inflation.

‡A part of the Department of Health and Human Services.

§Previous-year budget figures for the Department of Homeland Security reflect combined totals of its previously separate components.

Chilean Andes, and a network of seismic and other geophysical instruments spanning North America.

"We need to renew our science and engineering infrastructure across the board," says foundation director Rita R. Colwell. "If you're going to learn more about the cosmos, you've got to have the instrumentation to do it."

Among the agencies that lose R&D funding in this budget are the Department of Commerce, which includes the National Oceanographic and Atmospheric Administration. That department is scheduled to take a 10 percent hit. Also, the Environmental Protection Agency's expenditures are proposed to drop by 12.6 percent.

The Department of Agriculture will harvest a mere 0.2 percent more than it did in last year's budget proposal. —S. PERKINS

Mind Numbing

Anesthesia in baby rats stunts brain development

General anesthetic drugs that physicians commonly administer to children undergoing surgery, when given to baby rats, trigger brain cells to commit a cellular form of suicide that leads to lasting memory and learning deficits, neuroscientists have found. So far, there's no evidence of similar effects in children who have received anesthesia, researchers say.

As the brain develops, countless nerve cells branch out and meet up. Excess neurons are then pruned back through a programmed process of cell death, called apoptosis, which yields precise networks. In rats, connections form most abundantly in the first 3 weeks of life, whereas in people the most prolific connection making begins during the third trimester of pregnancy and continues for 2 to 3 years after birth.

Researchers have known for years that exposure to alcohol during the brain's growth spurt can ramp up cell death in rats and people. In children whose mothers drink heavily during late pregnancy, this cellular die-out can lead to hyperactivity and attention problems.

Like alcohol, anesthetic drugs stifle nerve cell activity. The anesthetics and alcohol act through the same mechanism. That led anesthesiologist Vesna Jevtovic-Todorovic of the University of Virginia in Charlottesville to ask whether early anesthesia might also share alcohol's influence on brain cells.

To find out, Jevtovic-Todorovic and her colleagues exposed 7-day-old rats to a triple cocktail of general anesthetics—midazolam, nitrous oxide, and isoflurane—a common combination in pediatric surgery. The treatment lasted 6 hours. Control rats received mock anesthesia treatments. The team killed some of the animals to study the pattern of brain-cell death and kept others alive for behavioral studies.

In the Feb. 1 *Journal of Neuroscience*, the scientists report that the anesthesia caused a substantial increase in cell death in many regions of the rats' brains including the hippocampus, a portion known for its role in learning and memory. Furthermore, 1-month-old rats that previously had been anesthetized scored poorly, compared with control rats, on tests of learning and memory. The rodents' mental deficiencies extended into adulthood, the team found.

"Rats that were given the anesthetic took longer to learn and tended to forget quickly, while control animals could go right back to a task," says Jevtovic-Todorovic. "Outwardly, they looked exactly the same."

Whether anesthesia's effects on young rats are relevant to people isn't known. Until it is, the results suggest "if surgery does not have to be performed early in life, it would be prudent to postpone it," says study coauthor John W. Olney, a neuropharmacologist at Washington University in St. Louis.

Neil L. Harrison, a neuroscientist at Cornell University in New York City calls the results "provocative." However, he warns against undue alarm. Doctors have administered anesthetics to babies "for many years without any apparent adverse effects," he says. —K. MORGAN

DIETARY DILEMMAS

Is the pendulum swinging away from low fat?

BY DAMARIS CHRISTENSEN

This time of year, thoughts turn from overloaded holiday tables to overweight bodies, the beach, and diet programs. Losing weight is not just a matter of looking good in a swimsuit. Packing on the pounds increases a person's risk of heart disease, diabetes, high blood pressure, stroke, and some cancers. Recent surveys estimate that more than 50 percent of adults in the United States are overweight.

As the U.S. public has gotten fatter, public health officials have been pushing diets low in fat. A variety of epidemiological data supports this advice, but it's now being challenged as other types of weight-loss diets have gained support.

"As a country, our fat intake has decreased, but our calorie intake has increased, and obesity rates are going up," says Bonnie J. Brehm of the University of Cincinnati. "Over the last 10 years, Americans have been so obsessed with low fat that people have forgotten that carbohydrates have calories, too. The pendulum may be swinging back a bit."

Some recent studies—and provocative articles in the popular press—have suggested that low-carbohydrate diets, such as the Atkins diet, could be more effective for weight loss than low-fat diets are. However, the low-carb diets tend to be high in fat and protein. So, there are concerns about their potential health effects. Although scientists caution that these diets haven't yet been studied over long periods, several new trials have shown them to have surprisingly positive short-term effects.

LOW-FAT LUNCHES The idea behind cutting fat out of weight-loss diets was that fatty foods represent the densest source of calories that a person eats, says Jennie Brand-Miller of the University of Sydney in Australia. Dieters have been told to replace high-fat items with fruits, vegetables, and grains.

Various studies have shown that such diets can help people achieve and maintain a healthy weight. In 2001, the U.S.-based Diabetes Prevention Program showed that low-fat, low-calorie diets combined with exercise produced a 5 to 7 percent weight loss over 6 years (*SN: 9/8/01, p. 150*).

Last November at the American Heart Association meeting in Chicago, researchers reported that among 74,000 women, those who increased their fruit and vegetable intake over the 12-year study period were 26 percent less likely to become obese than were women who decreased their consumption of such foods.

However, some scientists argue that low-fat diets aren't more effective than tracking calories. Early last year, an analysis of six studies that compared low-fat and fixed-calorie diets concluded that participants lost about the same amount of weight, 5 to 10 pounds. "The review suggests that fat-restricted diets are no better than calorie-restricted diets in achieving long-term weight loss in overweight or obese people," concludes Sandi Pirozzo of the University of Queensland in Australia. Furthermore, she notes, "the overall weight loss . . . in all studies was so small as to be clinically insignificant."

One reason that nutritionists had thought that people would lose more weight on a low-fat diet than on other calorie-restricted diets was that traditionally low-fat foods have been bulkier and higher in fiber than fattier foods. The nutritionists reasoned that people feel fuller after eating low-fat foods than after dining on other foods.

Over the past decade, the food industry's introduction of many low-fat choices has altered the relationship between fat, bulk, and fiber. Brand-Miller says, "New low-fat foods are not necessarily bulky. Nor are they low in calories because they often have added sugars." That means that it's become easier for people to eat low-fat meals and still add pounds.

Nevertheless, low-fat eating may have health benefits beyond any weight loss. Many epidemiological studies have shown that people who report eating diets low in fat and high in fruits and vegetables are less likely to develop heart disease and diabetes than people eating higher-fat diets are. The review of six studies concluded that participants in the low-fat group were slightly more likely to show a drop in cholesterol concentrations in their blood than were those in the fixed-calorie group.

In fact, one of the widely used low-fat diets was developed a decade ago to help people with heart disease reduce fatty buildup in their arteries. Dean Ornish, a professor of medicine at the University of California, San Francisco School of Medicine, developed a high-fiber diet in which less than 10 percent of the calories come from fat. That's about a third of the fat of a typical U.S. diet.

Most national health organizations have weighed in on behalf of low-fat diets. However, critics of these diets point out that the studies often encourage participants not only to change their diets but also increase exercise and learn stress-management strategies. Thus, in these tests, it's difficult to tease out the effects of any diet on weight loss.

Critics also note that high carbohydrate consumption can result in overproduction of insulin and eventually in people's becoming less sensitive to it (*SN: 4/8/00, p. 236*). This condition, called insulin resistance, may eventually lead to diabetes.

"What's becoming increasingly clear is that low-fat diets for peo-

ple with certain biological predispositions may increase their risk of developing the insulin-resistance syndrome," says endocrinologist David S. Ludwig of Children's Hospital Boston. He speculates that replacing fats with processed sugars and starches played a role in the development of current epidemics of obesity and diabetes.

PROTEIN POWER? One of the most popular low-carbohydrate diets today was devised and has been promoted by Robert C. Atkins, a cardiologist in New York City. The diet restricts carbohydrate consumption to less than 10 percent of total calories eaten, whereas people in the United States often get more than 50 percent of their calories from carbohydrates such as bread, processed foods, starch in vegetables, and sugar in fruits. People on the Atkins diet tend to eat at least 40 percent of their calories in fat, while the average U.S. diet contains about 30 percent fat calories.

The body's reaction to very low carbohydrate load is a condition called ketosis. According to Atkins' many books and magazine articles, people in ketosis preferentially burn stored body fat for energy—and burning fat takes more energy than burning carbohydrates does. Thus, he argues, dieters can lose weight while eating foods higher in calories than their previous choices.

Some researchers think there's another factor at play. They speculate that any benefits of a low-carb diet stem not from ketosis but from the diet's effects on blood sugar and insulin. A diet higher than average in protein and fat, which are digested more slowly than carbohydrates, might avoid carbohydrate-induced spikes of insulin in the blood that force blood sugar concentrations so low that the person feels hungry soon after eating, says Ludwig.

Critics of the Atkins diet say that it is likely to have dangerous side effects. Bone health is one concern about it and other low-carb diets.

"The huge load of animal protein ingested in such diets leaches calcium from the bones and sends it through the kidneys into the urine," says Neal Barnard, president of the Washington, D.C.–based Physicians Committee for Responsible Medicine. High protein intake increases the acidity of blood. In response, acid-neutralizing calcium gets pulled from bones. Also, excess urea from the protein pulls extra water into the kidneys, so dissolved calcium is expelled. "Over the long run, that can spell osteoporosis," says Barnard.

A study in the August 2002 *American Journal of Kidney Diseases* showed that after 6 weeks on the Atkins diet, the 10 participants made urine containing 55 percent more calcium than it had at the start of the trial.

People on meat-heavy diets are also more prone to kidney stones, gout, colon cancer, and potentially cardiovascular problems, Barnard adds. A high-fat diet might also boost the cholesterol and triglycerides, or free fatty acids, in people's blood. High cholesterol and fatty acid concentrations are linked to heart disease.

"Low-carb diets remain a serious health risk," Barnard says. To investigate potential health effects, as well as the effectiveness of such a diet, Eric Westman of Duke University in Durham, N.C., undertook a study funded by the Robert C. Atkins Foundation. He tracked 60 overweight people following a diet with less than 30 percent of its calories from fat and 60 others following the Atkins diet. As part of the diet, the Atkins group took supplements of fish oil, borage oil, and flaxseed oil. Westman reports that participants were more likely to stick to the Atkins diet than to the low-fat regimen.

Over 6 months, the people in the Atkins group lost 31 pounds, compared with 20 pounds for the people in the low-fat group. The changes in blood characteristics associated with heart disease were more favorable in the Atkins group, Westman says. Low-density-lipoprotein-linked cholesterol (the bad cholesterol) didn't change in blood samples from either group, while high-density-lipoprotein-linked cholesterol (the good cholesterol) went up slightly in the Atkins group but not in the other group. Triglyceride concentrations dropped in the Atkins group members' blood by almost twice as much as in the low-fat group's members.

> "You can lose weight on any diet."
>
> —GERALD REAVEN

"The findings were unexpected," Westman says, "but the results of several small studies seem to be consistent with ours."

With funding from the American Heart Association, Brehm also compared two diets. She randomly assigned 53 women to either a low-carbohydrate or a moderately low-fat regimen. On the low-carb diet, women were permitted to eat as much as they wanted as long as they kept carbohydrate calories to less than 10 percent of the diet. On the low-fat diet, the women were asked to eat between 1,200 and 1,500 calories per day.

At the end of 6 months, the low-carbohydrate dieters had lost about 18.7 pounds, including 9.9 pounds of body fat, while the low-fat dieters had lost 8.7 pounds, of which 1.6 pounds was body fat, Brehm and her colleagues reported at meetings late last year. "According to food records, both groups took in about the same amount of calories," Brehm says. Only the low-carb dieters showed signs of ketosis, she notes, so they burned more body fat for energy than the other group did.

Moreover, the low-carb diet—but not the low-fat diet—reduced blood concentrations of several markers of inflammation. Inflammation has been linked with heart disease and diabetes (*SN: 6/14/97, p. 374; SN: 8/ 31/02, p. 136*).

Blood pressure, cholesterol concentrations, and blood-sugar measurements weren't significantly different in the two groups and didn't change during the study. On the other hand, the amount of insulin in all the dieters' blood—measured before a meal—decreased in both groups during the 6-month study. That change typically indicates that a person is becoming more sensitive to insulin, a positive health sign.

A third major trial of an Atkins-style regimen enrolled 60 overweight men and women. Half followed a strict diet high in protein and low in carbohydrates, and the others adhered to a regimen lower in protein and higher in carbohydrates. Unlike the other trials, the researchers adjusted the volunteers' protein intakes to keep the percentage of fat the same in the two diets, says Peter M. Clifton of Australia's Commonwealth Scientific and Industrial Research Organisation in Adelaide. The two groups were matched for age and weight.

What we're eating

Dietary recommendations vary widely, depending on the source

	PROTEIN	CARBOHYDRATE	FAT
Average U.S. diet	15%	51-53%	32-34%
Ornish diet	Unrestricted	Unrestricted	<10%
Atkins diet	Unrestricted	<10% (excluding fiber)	Unrestricted
Most low-fat diets	Varies	Varies	20-30%
N.A.S. recommendation	10-35%	45-65%	20-35%

Over 16 weeks, the participants in both groups lost an average of about 18 pounds. Participants on the high-protein diet lost more fat and less muscle.

"There are subtle metabolic advantages for being on a high-protein diet, especially for women," says Clifton. The researchers measured no difference in blood-cholesterol concentrations between the two diet groups, but people on the high-protein diet had greater reductions of triglycerides in their blood. Also, over the course of the study, their sensitivity to insulin improved more than that of the other participants.

Several other small studies have shown similar results. All the researchers say they aren't prepared to recommend a low-carb diet ahead of other weight-loss plans, but they agree that the diet merits further investigation. The National Institutes of Health is funding a study that will track 360 participants at three universities for at least a year to compare the Atkins diet and a low-fat diet.

"We are trying to stay on top of the science here," says Robert Bonow, president of the Dallas-based American Heart Association. "People should not change their eating patterns based on very small, short-term studies. Bottom line, the American Heart Association says that people who want to lose weight and keep it off need to make lifestyle changes for the long term—this means regular exercise and a balanced diet including lots of fruits and vegetables."

WEIGHING THE ISSUES There's certainly room for improvement in the typical Western diet, says Brand-Miller. "There are good and bad high-protein diets, and there are good and bad low-fat diets," she says.

Although proponents of the Atkins diet argue that low carbohydrate intake has specific metabolic effects, some researchers still hold that all dieting is basically a matter of eating less. "People will lose weight on any diet, like the Atkins diet, that cuts out major groups of food because people get bored of eating the same thing day after day. But, in my experience, people find these diets very difficult to stick to," says Brand-Miller.

Though difficult in execution, dieting is simple in concept, says endocrinologist Gerald Reaven of Stanford University. "If you do carefully controlled studies, a calorie is a calorie is a calorie, and if you lower your calorie intake you lose weight. So, you can lose weight on any diet," he says.

The short-term dietary changes needed for weight loss are unlikely to have negative effects on health, he argues, especially given the benefits of weight loss.

STATS

$117 Billion

Cost of obesity in the United States

However, he takes a different view of the diets that people use over the long term to maintain their lowered weight. For example, a low-fat diet may be bad for people who are resistant to the effects of insulin, he says. Likewise, he argues, a low-carb diet may be bad for people with high cholesterol.

Reaven argues that the best long-term diet is one that contains moderate amounts of both fat and carbohydrates. Dietary recommendations released last year by the National Academy of Sciences suggest a diet of 10 to 35 percent protein, 45 to 65 percent carbohydrates, and 20 to 35 percent fat. Compared with previous guidelines, this new recommendation lowers the amounts of carbohydrates that people are told to eat and increases the permissible fat and protein, but it still rules out at least the initial phase of the Atkins diet, in which fruits or vegetables are strictly limited.

No matter how people do it, losing weight and keeping it off is a crucial public health issue. The federal government estimates that in 2000 the cost of obesity in the United States was more than $117 billion. Researchers agree that the rising numbers of overweight and obese people ensure that studies of diets and weight loss will be a burgeoning field for years to come. ■

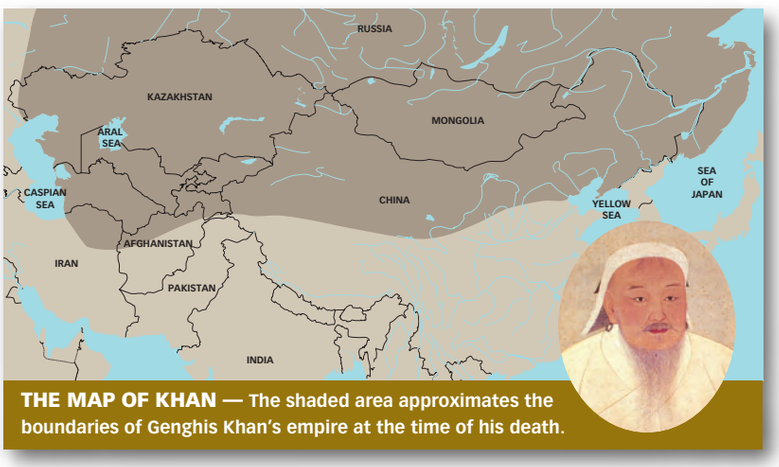
GENGHIS KHAN'S LEGACY?

The Mongol warlord may have left his imprint on the world's DNA

BY JOHN TRAVIS

Some 800 years ago, a fearsome, charismatic warrior named Temujin united the nomadic tribes of Mongolia. In 1206, he assumed the title Genghis Khan, often translated as emperor of emperors, and started invading surrounding territories. Massacring many of the people that he conquered, so as to leave no enemies and to strike fear in would-be foes, Genghis Khan ultimately controlled a massive empire ranging from today's Afghanistan across China. His male descendants continued the dynasty for many generations.

It appears that Genghis Khan left a mark on more than history: His influence may persist in the DNA of men today. According to an international team of geneticists, about 1 in 12 men in Asia—and therefore 1 in 200 men worldwide—carry a form of the Y chromosome that originated in Mongolia nearly 1,000 years ago. Today's unusual prevalence of this chromosomal variant is most likely the result of Genghis Khan's military success, the investigators say. Even more provocatively, the researchers suggest that Genghis Khan himself had this particular version of the Y.



THE MAP OF KHAN — The shaded area approximates the boundaries of Genghis Khan's empire at the time of his death.

Unlike other chromosomes, the Y exchanges little DNA with its partner, the X chromosome, when the sperm's DNA joins with the egg's. As a result, the Y chromosome retains a largely undisturbed record of mutations.

Using some 30 natural genetic markers, Chris Tyler-Smith of the University of Oxford in England and his colleagues classified the Y chromosomes of more than 2,100 men from locations across Asia. The markers included DNA deletions and insertions, as well as more subtle changes in the Y's DNA sequence. Other crucial markers were so-called microsatellites, regions of repetitive DNA that can expand or shrink from one generation to the next.

The scientists expected each man to show a unique combination of the DNA markers, and most did. However, they found that about 8 percent of the men carry Y chromosomes with identical or nearly identical markers, signifying a related ancestry, the researchers report in the online *American Journal of Human Genetics*. This minority lives in 16 different populations spanning a region of Asia from the Aral Sea in the west to the Yellow Sea in the east. "Finding one closely related group of lineages that is so widespread and at such high frequency is absolutely amazing," says Tyler-Smith.

Using estimates of the mutation rate of microsatellite DNA, the investigators conclude that the first man to have this particular form of the Y chromosome lived in Mongolia roughly 1,000 years ago. They argue that chance alone can't account for its modern dispersal and prevalence. Nor do they think that natural selection favoring certain gene variants explains the chromosome's rapid rise to prominence.

All the data point to Genghis Khan, according to Tyler-Smith. If this version of the Y chromosome was present in a significant percentage of his army, it could quickly have increased its distribution as the Mongols expanded their empire. Genghis Khan's habit of slaying people he conquered, especially males, would have helped this form of the Y chromosome displace others. It's even possible that just Genghis Khan and his sons may have had enough offspring to account for the chromosome's unusually high prevalence today, says Tyler-Smith.

Y DEBATE Other geneticists are divided on how to react to the idea that Genghis Khan himself was central to the spread of a particular Y chromosome.

"It's a bit melodramatic," says Peter Underhill of Stanford University. The Y chromosome data are "consistent with a recent Mongolian expansion. That's fine," says Underhill. "It's a question of if you want to imply that this is Genghis Khan's Y chromosome and that he left all these living descendants. It's hard to prove that."

"The problem is to be sure that this is the personal Y chromosome of Genghis Khan," adds Jaume Bertranpetit of the University of Pompeu Fabra in Barcelona. "Nonetheless, it is more likely that it is his Y than anyone else's in his time. He had the cultural fitness to spread his genes."

At least one scientific journal rejected the new report for publication because of its emphasis on Genghis Khan, acknowledges Tyler-Smith. "There's a reluctance to link genetic findings to historical individuals.

The investigators say they have indirect evidence that Genghis Khan carried the Y chromosome variant that caught their eye. Although few men in Pakistan have this specific Y chromosome, about a third of a group of Pakistani men known as the Hazara have it or a closely related one. The Hazara are of Mongolian origin, and oral histories hold that they're direct descendants of Genghis Khan.

Archaeologists have recently begun excavating a site in Mongolia that might hold Genghis Khan's tomb. Noting that geneticists have analyzed DNA from Neanderthal skeletons, Tyler-Smith suggests that the tomb's discovery could lead to a direct comparison of Genghis Khan's Y chromosome with those of modern men. ■

INSET: HOUTON ARCHIVE

ESSENCE OF G

Scientists search for the biology of smarts

BY BRUCE BOWER

Nearly a century ago, British psychologist Charles Spearman started what remains one of the most passionate debates about people's mental abilities. Spearman declared in 1904 that he had found the way to measure an individual's core intelligence. Using a mathematical method called factor analysis, Spearman noted that individuals score similarly on many items from a range of mental tests, some resembling today's IQ tests. Scores on these correlated items yielded a single factor, which Spearman called the general or *g* factor, that he deemed to be a marker of a person's facility for reasoning about any and all mental tasks.

Although Spearman had difficulty defining precisely what *g* measured or how it worked, he regarded it as more than a cold statistic. In his opinion, *g* tapped into "mental energy" that sprang from an unknown physical source. A meager trickle of this intellectual force mires people in retardation, a steady stream of it produces average intelligence, and a gusher promotes genius.

Scientists are still devoting considerable mental energy to exploring Spearman's notion. Enthusiasts for *g* hope to identify the measure's genetic and neural roots. Preliminary findings offer both encouragement and disappointing reminders of how little is known.

At the same time, critics regard *g* as a meaningless statistic that doesn't generate testable predictions about how intelligence works. Considerable leeway for personal judgment exists in conducting the type of mathematical calculations that Spearman did to come up with *g*, they argue. As a result, mental-test scores yield a single *g* in some studies but not in others.

Critics also charge that mental-test scores mainly reflect a person's social and emotional preparation for solving test problems, which are saturated with cultural assumptions.

Proponents of *g* couldn't disagree more. In his book *The* g *Factor* (1998, Praeger), Arthur R. Jensen of the University of California, Berkeley, presented accumulating statistical evidence for *g* that he says makes it imperative to discover what brain processes cause individual *g* differences. Other proponents say that their argument is being bolstered by research that's closing in on intelligence genes.

GENE HUNT Robert Plomin of the Institute of Psychiatry in London stands at the forefront of such research. "*g* shows significant genetic influence," he says. Plomin points to dozens of twin and adoption studies indicating that genes contribute substantially to individual differences in *g*.

Such studies find that genetic influences on *g* are modest among infants and children but become progressively stronger throughout adulthood. This suggests that, as people grow older, they find and create environments congenial to promoting their own genetic strengths, Plomin theorizes. "It may be more appropriate to think about *g* as an appetite rather than an aptitude," he says.

Many genes undoubtedly contributing in a minor way to differences between individuals on *g* or IQ scores, Plomin says. Such genes have so far eluded DNA researchers, however.

Consider the highly publicized link of a gene variant on chromosome 6 to high IQ (*SN: 5/9/98, p. 292*). In tests on 51 children, one form of a gene occurred more frequently in children with high IQ scores than it did in those with average IQs. However, this genetic disparity disappeared in a sample of more than 200 children, the same scientists reported in the November 2002 *Psychological Science.* Future research will need to compare tens of thousands of DNA markers across the genome in thousands of high- and average-*g* volunteers, says Plomin, a coauthor of the study.

A possible genetic clue to intellect and how it ages comes from a Scottish study led by Ian J. Deary of the University of Edinburgh. His team obtained IQ scores at age 11 and again at age 80 for 466 men and women of average intelligence. The 121 individuals possessing at least one copy of a specific variant of the apolipoprotein E gene, which influences brain-cell repair, performed as well as the rest at age 11. But at age 80, participants who had this gene form still scored in the average-intelligence range but at an average of 4 IQ points below their peers.

> "It may be more appropriate to think about *g* as an appetite rather than an aptitude."
>
> —ROBERT PLOMIN

The same apolipoprotein E gene variant has been linked with a susceptibility to Alzheimer's disease, suggesting that lower IQ scores in the Scottish sample reflect the early stages of that brain disorder. However, the number of those with the critical variant who displayed an IQ drop greatly exceeded the expected number of Alzheimer's disease cases in this sample, Deary says. The apolipoprotein E gene variant may instigate intellectual losses in elderly people who still exhibit average intelligence and healthy brains, he proposes.

Whatever the specific genes underlying *g*, large-scale studies of twins now suggest that genes largely coordinate the capability of high-*g* individuals to make simple perceptual discriminations more quickly than average-*g* people do. Two such studies were recently completed in Australia, by Michelle Luciano of the University of Queensland in Brisbane and in the Netherlands, by Danielle Posthuma of Vrije University in Amsterdam. Genes also foster a tendency for the brain to grow somewhat larger, relative to body size, in high-*g* individuals, Posthuma says.

These findings fit with a current theory that high intelligence arises from the coating of brain cells with especially large amounts of the fatty substance called myelin. Thick myelin may speed signal transmission. Thicker myelin coats translate into brains that are larger and can better coordinate rapid perceptual decisions, Posthuma says. "Genes important for myelination also may be important for cognition," she notes.

Using IQ instead of *g*, Paul M. Thompson of the University of California, Los Angeles and his colleagues found a link between high scores and a greater density of neurons in the brain's frontal

lobe. Their 2001 study of Finnish twins indicates that genes exert a substantial influence on the density of frontal lobe neurons.

Another brain-imaging investigation identified a specific frontal-brain region as a neural component of *g* (*SN: 7/29/00, p. 72*).

Neuroscientist Douglas Wahlsten of the University of Alberta in Edmonton says that none of these genetic and physiology studies defines a *g* factor. From his perspective, there is no genetically ingrained brain feature that determines a person's capacity for thinking or learning. This renders the search for intelligence genes futile, Wahlsten asserts.

Instead, he says, a person's genes flexibly participate in the process of brain development. Complex networks of interacting genes, which function in various ways depending on environmental forces, contribute to learning and intelligent behavior. Scientists need to specify these networks and how they work in particular contexts, in Wahlsten's view.

***G* TERRITORY —** In a controversial venture, scientists are seeking the genetic and neural roots of an intelligence measure known as *g*.

VANISHING ACT For a measure that inspires so much biological interest, *g* has a bad habit of disappearing when mental tests broaden their scope, asserts John Horn of the University of Southern California, a longtime critic of *g* theory. Other researchers contend that it is just an artifact of statistics or cultural variation.

When Horn performs factor analysis on a battery of tests that cover a wide range of mental abilities, he finds not one factor but as many as 10. These include:

- fluid reasoning, which is the capability to solve problems using unfamiliar information or procedures;
- comprehension-knowledge, a compendium of prior verbal and procedural experience;
- long-term memory;
- short-term memory;
- quantitative knowledge.

Several of these factors correspond to some of the "multiple intelligences" proposed by Harvard psychologist Howard Gardner.

What proponents of general intelligence refer to as *g* corresponds to only one or two of these many factors, depending on the nature of the mental tests being investigated, Horn says. "There is no *g*," he contends. "The emperor is naked."

Support for Horn's argument comes from a study of mental growth directed by John J. McArdle of the University of Virginia in Charlottesville. McArdle's group analyzed scores on a broad battery of tests administered to nearly 1,200 people ranging in age from 2 to 95. Each participant again completed the age-adjusted tests between 1 and 10 years later. Statistical analyses indicated that scores of the various mental abilities rose and fell along separate trajectories over time, the researchers reported in the January 2002 *Developmental Psychology*. A single *g* factor can't account for the divergent ways these thinking faculties develop, McArdle says.

Of course not, argues Peter Schönemann of Purdue University in West Lafayette, Ind. His research indicates that *g* is simply a statistical byproduct of the way mental tests are constructed. In fact, any set of moderately correlated findings, such as the number of toys and books that individual children have, yields data that can be transformed into a general factor having nothing to do with any "general ability," Schönemann holds. The various sections of mental tests have been painstakingly designed to contain items that are comparable in difficulty. This deep well of positively correlated items serves up a general factor on demand, he says.

People's IQ differences stem largely from the extent to which individuals' social and emotional background prepares them for mental tests, proposes Ken Richardson of Open University in Durham, England. In a review of the scientific literature on *g* and IQ, he concludes that middle-class children draw on extensive experience in manipulating written words and numbers to recognize the nature of nonverbal intelligence problems. This occurs even on those tasks that test developers argue are uninfluenced by culture, Richardson says.

These items typically require a child to look at a set of abstract forms, discern a pattern in the set, and then choose an abstract form that fits into the overall pattern. In these cases, the successful test taker needs to know to read symbols from the top left to the bottom right of a page, for instance.

Other qualities grounded in a person's experience, such as having an academic orientation and believing in one's capability to carry out a course of action, also affect performance on such tests, Richardson theorizes. These influences would ensure that *g* correlates moderately with education levels and job performance. The spread of formal education and literacy can probably take much of the credit for the escalation of IQ scores—5 to 25 points each generation—in Western populations over the past several generations, the British psychologist argues.

PRACTICAL SMARTS Richardson's argument resonates among African villagers living on the shores of Kenya's Lake Victoria. The higher their school-age children scored on a test of practical knowledge about herbal medicines used in their families, the lower the same kids scored on academic intelligence and achievement tests, says Robert J. Sternberg of Yale University.

Sternberg and his coworkers studied 85 Kenyan children, ages 12 to 15. In many of their families, parents spend much time teaching children practical types of knowledge, such as which plants to use for common medical ailments. Children exposed to extensive practical knowledge at home generally did poorly at school and on standard intelligence tests, Sternberg's team reported in 2001. Children whose parents emphasized academics got the best grades in school and the highest IQ scores but lacked a grasp of practical knowledge.

These findings underscore the importance of Western-style schooling for developing skills required to succeed on intelligence tests, Sternberg holds. Children who opt to develop other skills generate forms of intelligence that have nothing to do with *g* scores.

Even if *g* doesn't explain all aspects of intelligence, there are innovative ways to explore whether it has neural foundations, remarks Michael Atherton of the University of Minnesota in Minneapolis. In two brain-imaging studies directed by Atherton, novice players of chess and the Japanese board game called go showed widespread, largely comparable brain activation as they pondered moves when presented with arrays of game pieces. However, the two games seem to draw on different strategic skills. Unlike chess, go doesn't contain individually identified pieces that move in unique ways.

Atherton's findings, which need to be confirmed in expert chess and go players, suggest that a single network of brain regions underlies *g* and fosters strategic thinking, he says.

Still, he remarks, the scientific game is far from over. As of now, *g* remains a statistical entity in search of a biological identity. ■

OF NOTE

EARTH SCIENCE

Dust devils produce magnetic fields

Scientists who chase dust devils report that the tiny twisters can produce a small magnetic field that changes magnitude between 3 and 30 times per second.

When grains of sand and clay collide inside a dust devil, they generate electric charges, says William M. Farrell, a geophysicist at NASA's Goddard Space Flight Center in Greenbelt, Md. Negative charges typically transfer to the smaller, lighter particles, which are lofted higher than the heavier grains. As these charged particles swirl, they generate magnetic fields just the way electrons moving in an electromagnet's coiled wire do. Because a dust devil's charged particles move in circular paths at ever-changing speeds, they create a varying magnetic field.

On a typical summer day, several dozen dust devils spin across the dry lake bed in Nevada's Eldorado Valley. Farrell and his colleagues made their measurements by driving their instrument-laden pickup truck directly through or near dust devils. For one 10-meter-wide, 200-m-tall dust devil, the researchers could detect the magnetic field from several hundred meters away. The team reports its measurements in the Jan. 15 *Geophysical Research Letters*.

Similar instruments on a future Mars lander could measure the strength of Martian dust devils, which have shown up on images taken by the Mars Pathfinder lander and by probes orbiting the Red Planet. —S.P.

NEUROSCIENCE

Sleepy brains make memorable waves

Snoozing rodents provide clues to how a sleeping brain bolsters memories of recently learned material. Cells in two brain areas—the somatosensory cortex, which handles sensory information, and the hippocampus, which contributes to learning and memory—emit distinctive electrical waves in a timed pattern as mice and rats sleep, say György Buzsáki of Rutgers University in Newark, N.J., and his coworkers. This activity reflects a collaborative neural process that reinforces memories initiated during the day, the scientists suggest in an upcoming *Proceedings of the National Academy of Sciences*.

Buzsáki's team implanted electrodes in the brains of 10 mice and four rats. During a sleep phase known as slow-wave sleep, unique bursts of electrical activity in the somatosensory cortex were immediately preceded by characteristic electrical discharges in the hippocampus. This synchronized cell activity supports the notion that communication between the somatosensory cortex and the hippocampus during sleep fortifies memories, the researchers propose.

A growing number of scientists are trying to tease out the connections between sleep and memory (*SN: 6/1/02, p. 341*). —B.B.

MATERIALS SCIENCE

Microscopic glass ribbons provide molecular labels

A new type of barcode is too small to see with the naked eye, yet it holds big promise for biomedical research, law enforcement, and everyday life, say researchers.

The fluorescent tagging devices are short glass ribbons just 100 micrometers long and 20 μm wide. They contain stripes reminiscent of the black-and-white barcodes on milk cartons or cereal boxes, but these new barcodes tag large biomolecules, such as DNA. The labels become visible under a microscope when they're hit with a wavelength of light that makes them fluoresce.

BITSY BARCODES These glass barcodes can tag large biomolecules.

CORNING INC.

Other researchers have created molecular tags from fluorescing particles called quantum dots (*SN: 7/7/01, p. 7*) or tiny metallic bars overlaid with a sequence of precious-metal stripes, including silver and gold ones (*SN: 10/6/01, p. 212*). In contrast, the new barcodes are made of glass segments fused into ribbons. Each segment contains small amounts of ions of relatively rare metals, such as dysprosium, thulium, and cerium, which fluoresce in different colors.

Theoretically, the barcodes can be made in more than 100 billion patterns, says Matthew J. Dejneka of Corning in Corning, N.Y. Dejneka, Joydeep Lahiri, and their company colleagues describe the barcodes and their use in tagging genes in the Jan. 21 *Proceedings of the National Academy of Sciences*.

In addition to labeling biologically interesting molecules, the barcodes could serve as signatures that identify, say, a factory where a specific explosive was made or the paint from a car involved in a hit-and-run accident. They could also serve as invisible badges of authenticity for designer clothing or inks on paper currency, the researchers suggest. —J.G.

BEHAVIOR

Cell phones distract drivers, hands down

Calling all motorists: Using a hands-free cell phone while driving markedly interferes with the ability to maneuver a vehicle safely, according to several new tests.

In 2001, David L. Strayer of the University of Utah in Salt Lake City and his colleagues reported that people talking on either handheld or handsfree cell phones during simulated drives ran red lights more often and reacted more slowly to traffic signals than when not talking on a phone. No such problems occurred for drivers who either talked with a passenger or listened to the radio or to books on tape.

In new investigations led by Strayer, 110 college students operating a driving simulator caused more rear-end collisions and reacted more slowly to vehicles braking in front of them during periods when they talked on a hands free cell phone. The worst impairments occurred while driving in heavy traffic, the researchers report in the March *Journal of Experimental Psychology: Applied*.

Cell-phone conversations sapped the attention required to discern important driving cues, Strayer holds. For instance, immediately after taking simulated drives past a series of billboards, volunteers could recall fewer of the signs if they had been talking on a handsfree cell phone. Yet eye-tracking tests showed that drivers looked directly at two-thirds of the billboards, whether or not they used a cell phone.

In another test, volunteers used a joystick to align a cursor with a moving target on a computer screen. At the same time, a series of words flashed briefly on the screen. Participants later recognized fewer of those words if they had been talking on a handsfree cell phone during the exercise.

Strayer's prescription: Don't drive while yapping on the phone. —B.B.

Books

A selection of new and notable books of scientific interest

A MAP OF THE CHILD: A Pediatrician's Tour of the Body

DARSHAK SANGHAVI

When he was a young doctor training at Boston's Children's Hospital, Sanghavi worked briefly in several specialties. Similarly, this book is a crash course in how anatomy, physiology, psychology, and public health policy affect children. Chapter by chapter, Sanghavi examines major organs in the body: lungs, heart, blood, bones, brain, skin, gonads, and guts. He provides an engaging and accessible look both at how the organs develop in a fetus and what can go wrong with them. Through stories about patients he has cared for, he tells, for instance, how the lungs mature as well as how physicians treat asthma. Moreover, he tackles some of the most contentious issues in pediatrics, including circumcision, vaccinations, and teen pregnancy. ***H Holt & Co, 2003, 305 p., hardcover, $24.00.***

MURDER AND MAYHEM: A Doctor Answers Medical and Forensic Questions for Mystery Writers

D.P. LYLE

Where do writers for television shows, such as *Law and Order*, or authors of crime novels turn when they need technical answers to medical questions? One of the first places is the author of this book, cardiologist D.P. Lyle. This collection of questions and answers is culled from Lyle's regular column in publications produced by the Mystery Writers of America. In this book, readers learn how dangerous or safe it is to handle cyanide, what the most lethal knife wounds are, how long someone can survive in a freezer, and what a wound from a close-range gunshot looks like. ***Thomas Dunne, 2003, 278 p., hardcover, $23.95.***

RETURN OF THE CRAZY BIRD: The Sad, Strange Tale of the Dodo

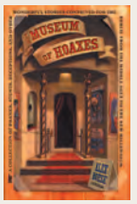
CLARA PINTO-CORREIA

The dodo's history is just about as crazy as its name. This large, flightless bird was discovered in the early 16th century by Portuguese and Dutch explorers on the island of Mauritius. Before then, it lived peacefully, eating nuts that it cracked open with its powerful beak. It had no known predator. However, the bird was food for the hungry sailors and an oddity to Europeans. Within 100 years after its discovery, the dodo was extinct. All that was left were some drawings and a single foot and skull. Pinto-Correia tracks the legend of the dodo. ***Copernicus, 216 p., b&w images, hardcover, $27.50.***

THE MUSEUM OF HOAXES

ALEX BOESE

This collection of pranks, stunts, deceptions, and other stories tracks the myriad ways people have been duped from medieval times to the present. It seems no one is immune. Boese details schemes that fooled The New York Times, Jimmy Carter, and the Queen of England. Mischief makers have convinced the public that a woman could give birth to rabbits and a hen could lay square eggs. Boese also details a recent scientific fraud, in which a fossil found in China passed muster, among some scientists, as the missing link between dinosaurs and birds. In this whimsical tour, Boese illustrates how hoaxes persist—especially today with the aid of the Internet. This book will probably reveal to many readers that some "facts" they thought they knew aren't true. ***Dutton, 2002, 266 p., hardcover, $19.95.***



THAT'S THE WAY THE COOKIE CRUMBLES: 62 All-New Commentaries on the Fascinating Chemistry of Everyday Life

JOE SCHWARCZ

Do growth hormones extend life? Why is cabbage good for you? How do firewalkers tolerate hot coals on their feet? On his popular Canadian-radio show, Schwarcz answers questions such as these as he debunks pseudoscientific claims and helps people understand sound scientific data. This collection of vignettes includes the origin of soda pop, the history of Plexiglas, and the effects of lead poisoning on the Roman ruling classes. ***ECW Pr, 2002, 273 p., paperback, $14.95.***

WHEN SMOKE RAN LIKE WATER: Tales of Environmental Deception and the Battle against Pollution

DEVRA DAVIS

Professionally, Davis has spent her career as an epidemiologist researching links between environmental pollution and human health. Personally, she has been touched by the pursuit, as well. She grew up in a Pennsylvania valley where 20 people perished in a single day allegedly because of smog from industrial sources. This is a far-reaching survey of risks associated with industrial toxins and how those risks can be managed. The author argues that in the same way we inspect bridges so they won't fall down, we should address issues of toxic pollution before people get ill or die from it. She reveals instances in which science has been manipulated for corporate gain and at the expense of citizens' health. For instance, she writes that the Ethyl Corporation fought to keep lead in gasoline while evidence grew of the dangers of air pollution from the metal. Other corporations litigate endlessly to resist changing work environments that are obviously dangerous, she charges. This compelling book is a 2002 National Book Award finalist. ***Basic, 2002, 316 p., b&w plates, hardcover, $26.00.***

LETTERS

Fine tune

It's no surprise to find that the Borneo tree frog tunes into his tree hole ("Frogs Play Tree: Male tunes his call to specific tree hole," *SN: 12/7/02, p. 356*). From the resonance of electron shells to the orbits of planets, stars, and galaxies, harmonic relationships define all of creation. Many frogs have external tympanic membranes that resonate to their tiny chirpings. This mechanism helps put entire ponds full of frogs in sync.

ANDY BARNETT, GAEBERVILLE, CALIF.

Bubble trouble

"Deadly Bubble Bath: Ultrasound fizz kills microbes under pressure" (*SN: 12/7/02, p. 358*) says that in cavitation, "bubbles form when falling pressure permits dissolved gases to pop out of solution." A cavitation-vapor bubble is formed when the pressure drops below the vapor-liquid saturation pressure for the liquid. Dissolved gas bubbles will just give you a fizzy cola.

A.J. MCPHATE, BATON ROUGE, LA.

Don't cut down the trees

"Solving Hazy Mysteries" (*SN: 12/7/02, p. 360*) shows hazy pictures from Great Smoky Mountains National Park and says the cause of the haze is "volatile organic compounds released by trees." I'm the air-quality specialist in the park, and I know that 60 percent of the particle mass in the air is sulfate from power plants, not trees, and 80 percent of the haze is from sulfate, not trees. This article is misleading, and pictures of the park should not have been shown, especially if none of the work related to this story was done in the park.

JIM RENFRO, GATLINBURG, TENN.

Rough riders

"Jarring Result: Extreme biking can hurt men's fertility" (*SN: 12/7/02, p. 355*) recommended shock absorbers and cushioned seats. Did this study survey what type of bikes the volunteers rode?

DOUG LANDON, SIMI VALLEY, CALIF.

Study coauthor Ferdinand Frauscher notes that although most of the long-time bikers now use bikes with shock absorbers and padded seats, they almost all originally rode bikes with little or no padding and no shock absorbers. —N. SEPPA

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The Amazing Body

How well do you know your own body? Why do your ears affect your sense of balance? Why is your blood red?

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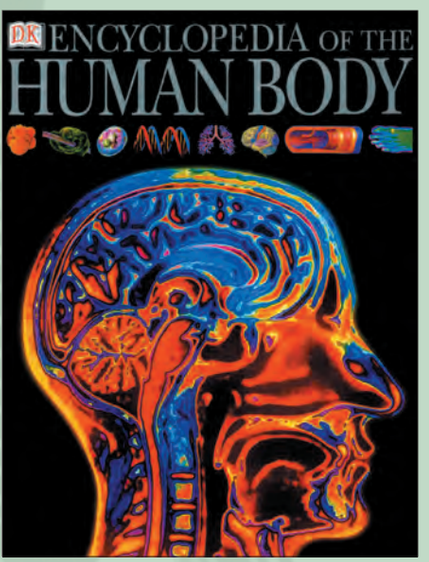
—from Dorling Kindersley



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