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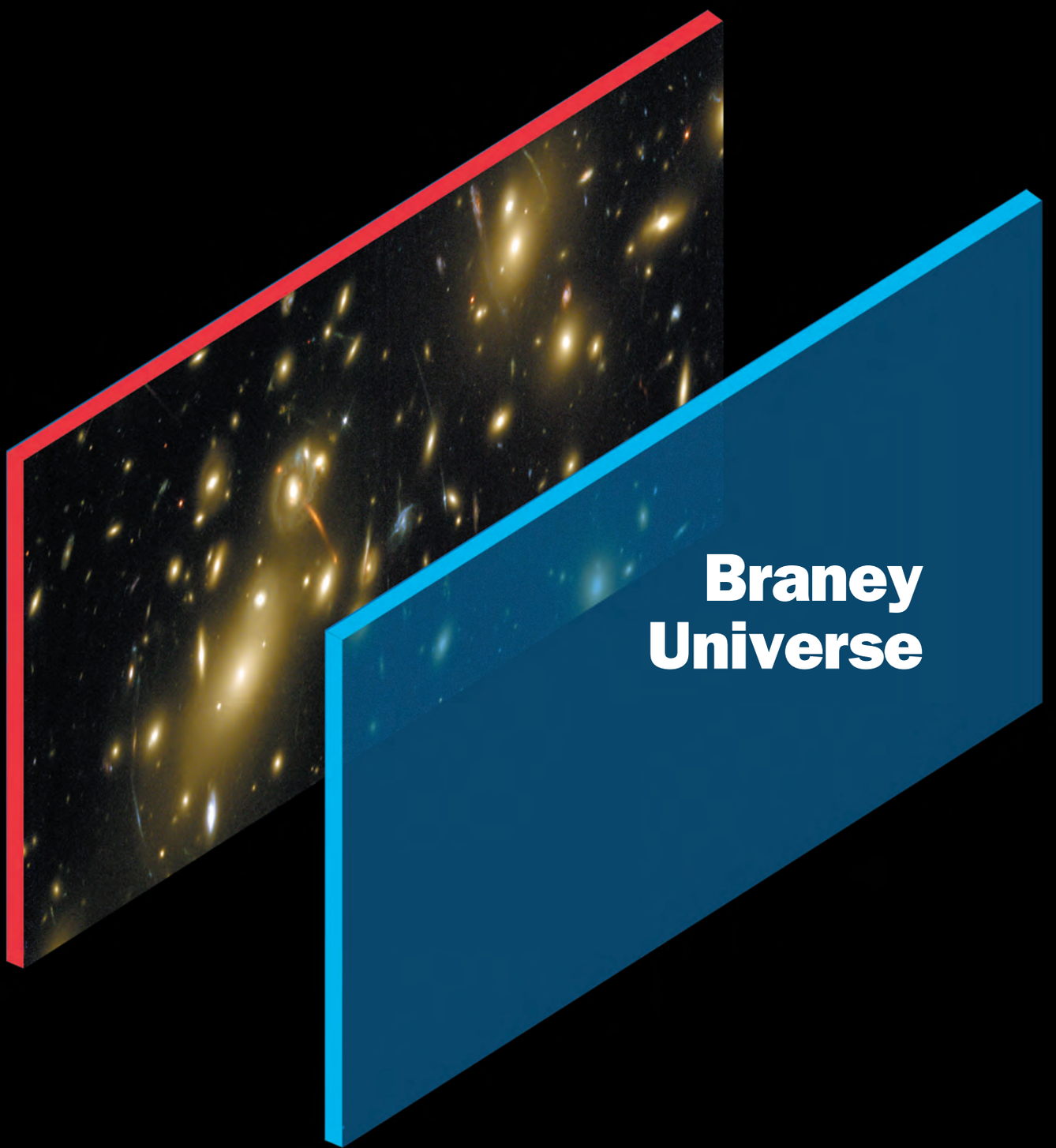

Braney Universe

SCIENCE NEWS BOOKS

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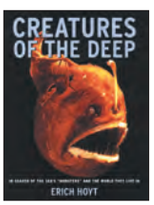
The Big Bang: The Birth of Our Universe—Paul Parsons. Concise and accessible, this book provides both advanced students and novices with an overview of the fundamentals of cosmology. Snapshot chapters reveal the history of the Big Bang theory and the questions that still dog researchers about the composition and future of the universe. The book benefits from extraordinary imagery and data generated from the latest research in the field. Parsons introduces many important cosmology theorists and explains how they have shaped our view of the universe. DK Pub Inc., 2001, 96 p., color/b&w photos/ illus., hardcover, $12.95.



Creatures of the Deep: In Search of the Sea's "Monsters" and the World They Live In—Erich Hoyt. Until a few years ago when technological advances overcame the crushing pressure and extreme cold of the ocean depths, many people believed that monsters lurked in this unfamiliar territory. Hoyt examines the ecosystem of the deep sea and our efforts to explore and document it. As he goes, he demystifies the animals that live there. He pinpoints five depth zones of the deep sea—the area beyond the continental shelf that extends to the ocean floor. Tours of each zone turn up a bevy of interesting life-forms including squid that grow to at least 57 feet long and dragonfish that possess the ability produce and see red light at the blue-black depths of about 3,000 feet. The book benefits tremendously from vivid color photographs of the featured creatures. Firefly Bks Ltd, 2001, 160 p., color photos, hardcover, $40.00.

The Eureka Effect: The Art and Logic of Breakthrough Thinking—David Perkins. All Archimedes had to do, it seems, was take a bath in order to have one of his greatest inspirations—the principle of displacement of water. Perkins explores the nature of such eureka moments, or as he calls it, "breakthrough thinking," and concludes that the occurrence of such notable cognitive moments can actually be cultivated. A codirector of Project Zero, a think tank at Harvard University, Perkins crafts a theory of breakthrough thinking based on "Klondike space." He fashions that term from the Klondike gold fields, where the potential for gold is great but the terrain is riddled with perils. Through hundreds of puzzles and historical examples, Perkins illustrates how to solve problems using the strategies of breakthrough thinking. Originally published in hardcover in 2000 under the title *Archimedes' Bathtub.* Norton, 2000, 292 p., illus., paperback, $14.95.

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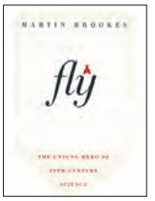

Fly: The Unsung Hero of 20th-Century Science—Martin Brookes. White mice are most commonly associated with scientific experimentation. However, the tiny fruit fly has actually facilitated some of the most profound achievements in biological research. In fact, Brookes boldly asserts, "everything in modern genetics from gene therapy to cloning to the Human Genome Project" stems from early fruit fly research. This is a boast that he eloquently and effectively defends. As Brookes tells it, fruit flies became the darlings of biologists because they are cheap and easy for scientists to work with. Hundreds can be housed in a small space, they have small appetites, and their short life span allows scientists to observe complete lifecycles in just a few weeks. After recapping the glory years of fruit fly experimentation in the early 20th century, Brookes explains how "a quartet of biological simpletons"—viruses, bacteria, yeasts, and molds—pushed the fly out of the limelight. He then recounts the fruit fly's resurgence since the early 1970s and its role in helping scientists address important questions: How do genes link one generation to the next? Why do we age and how can we prevent it? How does a single fertilized egg become an adult with billions of cells? Brookes turns this tiny insect's life and times into a fascinating and entertaining portrait. Ecco Pr, 2001, 215 p., hardcover, $24.00.

Plant Partners: Creative Plant Associations for Perennials—Anna Pavord. Rather than settle for flowers that bloom in spring, wither, and leave nothing behind, Pavord shows how to group plants that will complement each other's flowers and foliage through the seasons. She focuses on 60 perennials, bulbs, biennials, and annuals—no trees or shrubs—and pinpoints two companions for each. At least one of the three plants in each combination will continue to have appeal even after all the flowers fall. Two pages devoted to each plant trio feature color photographs, a brief synopsis detailing how the plants work together, the climate they prefer, how to plant and care for them, and some troubleshooting tips. The book is arranged by season, and each chapter opens with general ideas for effective planting during that time. Pavord offers aesthetic advice, as well. DK Pub Inc., 2001, 240 p., color photos, hardcover, $19.95.

Volcanoes: In America's National Parks—Robert Decker and Barbara Decker. Remarkably, 38 national parks and monuments include volcanoes. The Deckers visit them all. Located in Hawaii, Alaska, California, Idaho, Arizona, New Mexico, and Oregon, the parks include Mount Rainier Park in Washington and the volcanic rock outcrops of Arizona's Chiricahua National Monument. A brief chapter offers readers insight into the science of volcanoes. Other chapters profile individual parks with glorious color photographs and informative historical overviews. Included are details of the volcanoes and other attractions at each park, maps, directions, lists of what visitors should bring, fees charged, and lodging and contact information. Odyssey Pubns, 2001, 256 p., paperback, color photos/illus., paperback, $24.95.

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SCIENCE NEWS®
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Volume 160, No. 12, September 22, 2001

This Week

Articles

Research Notes

Departments

Cover: In a controversial new theory, for eons our cosmos lay dormant—a frozen, featureless void. Then, a parallel universe (blue) moving along a hidden dimension smacked into it, igniting the Big Bang and setting the stage for galaxy formation. In this theory, each universe is represented by a three-dimensional membrane, or brane, embedded in a higher-dimensional space. **Page 184** (Image: Paul Steinhardt *et al.*)

Letters

No stone unturned

I am writing in response to an article in the July 28 issue, "Having gathered moss, water drops roll" (SN: 7/28/01, p. 57). You should have taken the time to find out that *Lycopodium* is not a moss. It's true that a common name for the plant is club moss, but *Lycopodium* is in the division Lycophyta, sometimes called seedless vascular plants or fern allies.

Ann E. Rushing
Baylor University
Waco, Texas

You report inaccurately that water droplets normally "dribble like tears down a slanting surface." Close observation will show that every solo trickle of water in fact has a well-defined spherical head. It's quick and easy to miss, but definitely observable. Because it usually leaves a trail as it rolls down the surface, a solo trickle may seem to be tear-shaped, but actual tear-shaped drops are only the ones that have not broken the grip of surface tension adhesion. Other easily observed "liquid marbles" are found almost any time you turn a water hose on the top of a car, especially if the spray is backlit by the sun. You almost always see a profusion of little spheres bouncing and scattering without adhesion over the wet surface.

Phil Henshaw
New York, N.Y.

Where there's smoke

The study in "Marijuana may boost heart attack risk" (SN: 7/14/01, p. 31) appears to be more about the effects of smoking and deep inhalation than a useful examination of the effects of tetrahydrocannabinol, which is what marijuana smokers seek. The report makes it sound as though this active ingredient is the cause of the marginal increase in heart attacks, whereas it is probably due to smoking—whether that be of marijuana, tobacco, or oak leaves.

Marijuana smokers inhale unfiltered smoke and hold it in their lungs for a prolonged period. A major component of this smoke (as well as that of cigarettes) is carbon monoxide. This will cause, of course, a sudden reduction in blood-oxygen partial pressure and affect a heart already partially oxygen-compromised by coronary artery disease.

Peter Nelson,
Nevada City, Calif.

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New Fossils Resolve Whale's Origin

Recent fossil finds from Pakistan overturn the picture of whale evolution long championed by paleontologists, bringing them closer to agreement with an alternative view proposed by molecular biologists. The discoveries establish a close evolutionary link between cetaceans, which include whales, dolphins, and porpoises, and a group of mammals known as artiodactyls. These hoofed animals with an even number of toes include cows, sheep, goats, pigs, deer, and hippopotamuses.

Four-legged, terrestrial ancestors of whales and other cetaceans waded into the sea about 55 million years ago and gradually developed skeletal adaptations for aquatic life, paleontologists hold. But precisely what variety of land mammal first got its feet wet has been a source of spirited debate (SN: 11/6/99, p. 296).

"We've thought since the '60s that whales evolved from hoofed, carnivorous mammals" known as mesonychians, says Philip D. Gingerich of the University of Michigan in Ann Arbor. Like most paleontologists, he says, he "considered it pretty well established" on the basis of dental similarities that cetaceans were surviving descendants or close relatives of this otherwise extinct group.

However, Gingerich's latest report, in the Sept. 21 SCIENCE, removes whales from the mesonychians and places them in the same evolutionary lineage as artiodactyls—just as researchers analyzing genetic and immunological data have maintained.

Gingerich and his colleagues reversed their position after analyzing the skeletons of two early aquatic whales, about the size of sea lions, that they unearthed last year in central Pakistan. The fossils, which they gave species names of *Artiocetus clavis* and *Rodhocetus balochistanensis*, are the first of cetaceans ever discovered with intact ankle bones.

J. Klausmeyer/SCIENCE

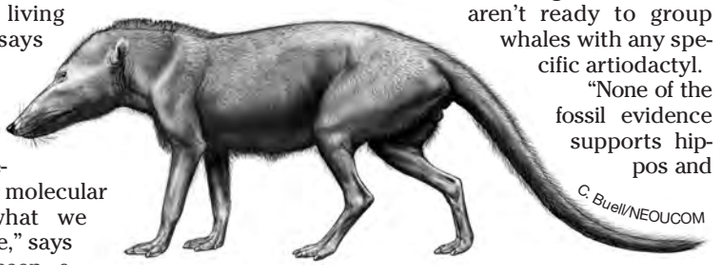
An artist's rendering of a largely aquatic early whale of the genus Rodhocetus. *This mammal lived near the shores of the Tethys Sea, between Asia and the South Asian subcontinent, about 47 million years ago.*

To the researchers' surprise, the ankle had a unique form that's found only in artiodactyls. Since living cetaceans have no vestige of these bones, the discovery of early whales with distinctly artiodactyl ankles provides a "Rosetta stone" linking modern marine mammals to living artiodactyls, says Gingerich.

"The new [fossil] data are much more in agreement with the molecular data than what we thought before," says J.G.M. Thewissen, a paleontologist at the Northeastern Ohio Universities College of Medicine in Rootstown. Working independently in fossil beds in northern Pakistan, he and his colleagues have concluded that pakicetids, a group ancestral to modern cetaceans and predating the transition to marine life, also had the artiodactyl ankle form. They report their work in the Sept. 20 NATURE.

The new finds are "very exciting for those of us working on molecular data," says John Gatesy, an evolutionary biologist at the University of California, Riverside, whose work in nuclear DNA sequencing supports a close whale-artiodactyl relationship.

Gatesy's data and other lines of molecular evidence also suggest that whales have a closer evolutionary relationship with hippos than with other artiodactyls. Paleontologists, however, aren't ready to group whales with any specific artiodactyl. "None of the fossil evidence supports hippos and whales as being sister taxa," says Kenneth D. Rose, a paleontologist at the Johns Hopkins Medical Institutions in Baltimore.



C. Buell/NEOUCOM

Approximately 50 million years ago, this wolf-size pakicetid—an ancestor of the whale—lived on land but may have waded into streams to feed on fish.

Nevertheless, Gingerich predicts that renewed focus on the fossil record of early artiodactyls will help researchers determine just where the whales fit in. And that, he acknowledges, could be alongside the hippos. *—B. Harder*

Even a little coffee may up heart risk

Nothing jolts the body into action in the morning like a strong cup of coffee. However, people concerned about heart health may want to limit their intake, a new trial suggests.

Several oily coffee-bean components can elevate cholesterol in a person's blood. Although the paper filters of drip coffeemakers largely eliminate those oils (SN: 2/4/95, p. 72), drinking even filtered coffee can increase blood concentrations of the amino acid homocysteine, another risk indicator (SN: 1/11/97, p. 22).

Norwegian scientists have now investigated these coffee-borne factors in a 6-week trial of 191 nonsmokers. All had been downing an average of 5 cups of coffee daily.

Benedicte Christensen of Ullevål University Hospital in Oslo and her colleagues randomly assigned equal numbers of these people to give up coffee altogether, to limit their intake to 1 to 3 cups of filtered coffee per day, or to drink at least 4 cups daily. At the beginning, middle, and end of the trial, Christensen's team measured cholesterol and other heart-risk indicators in the participants' blood.

Only those who went cold turkey on coffee showed a significant change—a drop—in two key indicators, Christensen's team reports in the September AMERICAN JOURNAL OF CLINICAL NUTRITION. During the trial, blood cholesterol fell an average of 5 percent in the no-coffee group; homocysteine fell 12 percent.

According to the researchers, calculations from previous studies have indicated that a cholesterol drop of this magnitude could cut the incidence of heart disease by about 15 percent. The observed homocysteine drop corresponds to a 10 percent decrease in heart risk.

So far, studies of coffee drinking and heart attacks have had conflicting results. The new study doesn't directly link coffee to disease. Even so, Christensen speculates that java could be part of the complex equation behind heart disease, including other risk factors and a person's overall health. *—J. Raloff*

Model may expose how friction lets loose

Friction is at play wherever surfaces meet, and it always begins with atoms. Atomic theories of the phenomenon usually focus on interatomic bonds, shared vibrations, and other surface-to-surface interactions as friction's ultimate source.

Now, two Texas-based physicists have modeled surface slippage—friction's retreat—as bands of atoms in the top surface momentarily leaping up from the underlying surface. Millions of such ripples propagate simultaneously along the interface when, for instance, a book slides on a table, they say.

Scientists have long known that friction on the scale of books and tables obeys simple laws. As French physicists Guillaume Amontons and Charles-Augustin de Coulomb established in the 17th and 18th centuries, the sideways force needed to overcome the friction between surfaces is proportional to the forces, such as weight, pressing the surfaces together. Surprisingly, the size of the friction-defeating force is independent of the area of the surfaces in contact.

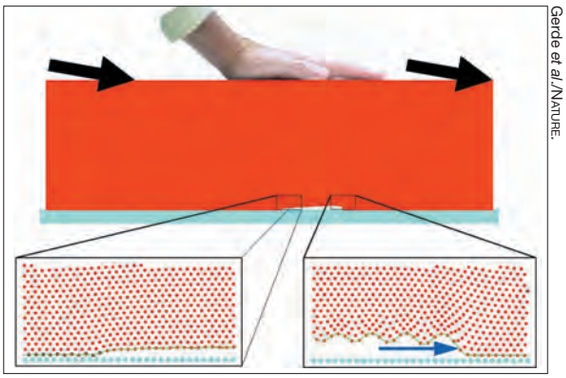
For years, physicists have tried to explain this large-scale behavior in terms of atomic-scale events. They've had some success by portraying surfaces as jagged on an atomic scale. That way, very little material actually touches. However, scientists still struggle to explain why protrusions from two surfaces would stick together at all.

There's incentive to find out. A better understanding of friction could improve scientists' grasp of countless phenomena, such as engine performance and tool wear. Moreover, friction is particularly vexing for developers of micromachines (SN: 7/22/00, p. 56).

In the new mathematical model, Eric Gerde and Michael P. Marder, both of the University of Texas at Austin, build upon the physics of how cracks form and propagate through solids. Think of a bump in a rug, says Marder. As people know from everyday experience, pushing such bumps along can move a big rug over a floor.

Something similar may be happening at the atomic scale between sliding surfaces. Marder says that the combination of downward and sideways forces on an object sliding along an underlying surface can translate into upward forces that open "cracks" at the interface, akin to bumps in a rug. These cracks amount to a series of arches, each a few atomic diameters across. As these waves of separation advance along the interface, the overlying surface comes back down behind each wave and reconnects with the surface below.

A plus for this hypothesis, presented in the Sept. 20 NATURE, is that it predicts the simple relationship between compressive forces, like weight, and frictional forces. Yet it doesn't require the surfaces to be rough on an atomic scale, as previous models do. Other scientists have theorized about such cracking before and have even seen hints of it in the lab and at earthquake faults. Previous attempts to mathematically represent surface-separating ripples, however, have led to nonsensical implications, including solid surfaces passing through each other like ghosts.



Gerde *et al.*/NATURE

Downward and lateral force on a block may cause upward movement of atoms (right-hand box) that unzips weak bonds and permits sliding.

David A. Kessler of Bar-Ilan University in Ramat-Gan, Israel, calls Gerde and Marder's work a "mathematical tour de force" in a commentary in the same issue of NATURE. "Whether it also helps to solve the problem of friction . . . remains to be seen," he adds.

Marder concedes that his team's current model may not explain everything about surface sliding, and he looks to experiments planned by Jay Fineberg of the Hebrew University in Jerusalem to fill in gaps or show where the model falls short. Fineberg and his colleagues plan to use high-speed cameras and acoustic sensors to seek signs of the friction-releasing ripples on the surfaces of transparent pieces of Plexiglas as they move over glass surfaces. *—P. Weiss*

Ceramics stretch for future applications

Everyone with kitchen experience knows how easy it is to break a ceramic plate. Less well known is the capability of some ceramic materials to become soft and pliable when heated. For years, materials scientists have hoped to exploit this unusual property to develop ceramics that can be machined into intricate parts as easily as metals or polymers can.

A team of Japanese researchers has now overcome one obstacle to using so-called superplastic ceramics commercially. It has made a ceramic that can stretch quickly enough to appeal to manufacturers.

Engineers often find ceramics attractive for products such as spacecraft coatings and automobile engine parts because the materials can withstand more extreme conditions than many metals can, says team member Byung-Nam Kim of the National Institute for Materials Science in Tsukuba, Japan. Ceramics are hard, lightweight, chemically resistant, and electrically insulating. On the other hand, it's much easier to mold a metal or polymer into a desired form than to shape conventional ceramics.

That's where superplastic ceramics might come in. Researchers can fashion these materials into a desired shape while they're hot and then allow the material to cool and harden.

Yet the superstretchy ceramics, which were discovered 15 years ago in Japan, haven't yet taken hold commercially, comments materials scientist T.G. Nieh of Lawrence Livermore (Calif.) National Laboratory.

One reason for this, he says, is that the materials developed so far require slow stretching. For example, one superplastic ceramic created by another research team takes 20 hours to stretch to about 10 times its initial length before breaking. That's too slow to be commercially viable, says Nieh.

Now, however, Kim's team has made a ceramic that can undergo an elongation of more than 10-fold in just 25 seconds. "We believe the present ceramic can be deformed more," Kim adds. The material didn't break even when the team's stretching apparatus reached its maximum.

The material is made from certain high purity powders of alumina, magnesia, and zirconia. When heated and stretched like chewing gum pulled into a string, it thins uniformly, Kim's group reports in the Sept. 20 NATURE.

The ceramic can behave this way, says Kim, because the original components create a mix of three types of grain that suppresses the growth of individual grains, and small particle size permits the material to easily stretch.

The increased rate of such stretching constitutes a long-sought "breakthrough," comments Nieh. Still, like other superplastic ceramics, the new material has an Achilles' heel—cost. The price of the raw materials must fall before such ceramics will come into widespread use, he says.

If that happens, Nieh suspects that superplastic ceramics' manufacturing properties could make them especially attractive for creating small, intricate forms, such as parts of implants used in the body, where ceramics' chemical inertness would be valuable. *—J. Gorman*

Drugs slow diabetes patients' kidney damage

Two drugs prescribed for high blood pressure show signs of forestalling kidney damage in people with type 2, or adult-onset, diabetes, according to three new studies. The findings, reported in the Sept. 20 NEW ENGLAND JOURNAL OF MEDICINE, could give physicians a new way to block this dangerous complication.

High blood pressure can lead to kidney problems, particularly in people with diabetes. While scientists don't fully understand the causes of high blood pressure, they know that a hormone called angiotensin can contribute to it. Some blood pressure medications offset angiotensin's effects in much of the body, but they aren't as effective in the kidneys.

Part of the problem lies in the kidneys' unusual design. Blood enters the organs via arteries and then fans out into microscopic capillaries. There, clusters of cells called glomeruli filter out impurities, dumping them into the urine. However, the blood doesn't flow directly back into veins heading out of the kidney. Instead, it gathers in another artery and spreads into more capillaries to nourish kidney tissues before it finally exits.

Although the blood pressure medications that have been in use the longest relax the arteries entering the kidneys, they don't always act adequately in the internal kidney capillaries. A bottleneck can ensue that swamps the glomeruli with high-pressure blood and damages them, says Barry M. Brenner of Brigham and Women's Hospital in Boston.

Seeking to prevent such damage, scientists in the early 1990s began testing blood pressure drugs called angiotensin-converting enzyme (ACE) inhibitors to see if they improve kidney function. These drugs suppress the enzyme that triggers angiotensin production. They limit kidney damage, but whether they confer full protection remains unproven.

Taking yet another approach, Brenner and his colleagues gave diabetes patients losartan, a drug that occupies docking sites on cells to which angiotensin would otherwise bind.

The researchers assigned 327 diabetes patients who had high blood pressure and some kidney damage to receive either losartan or an inert pill. The patients also continued taking standard blood pressure drugs. After 3.4 years, the patients getting losartan were significantly less likely to have any of three outcomes: damaged glomeruli leading to a doubling of the compound creatinine in the urine, kidney failure, or death.

Although losartan has been on the market for several years, physicians generally prescribe it for high blood pressure, not kidney problems. "This is a novel use," Brenner says.

The other two studies examined another blood pressure drug, irbesartan, which also blocks angiotensin receptors. Edmund J. Lewis of Rush–Presbyterian–St. Luke's Medical Center in Chicago and his colleagues assigned 1,715 patients with high blood pressure to receive either a placebo, irbesartan, or a drug called amlodipine, which relaxes artery spasms. After nearly 3 years, the irbesartan group was only two-thirds as likely as the other groups to show doubled creatinine concentrations in their urine.

When blood can't flow through the glomeruli smoothly, scar tissue forms, leaving part of the organ damaged, Lewis says. Although losartan and irbesartan may not reverse kidney damage, they could delay by 2 or 3 years the day when a person with diabetes and kidney problems needs dialysis, he estimates.

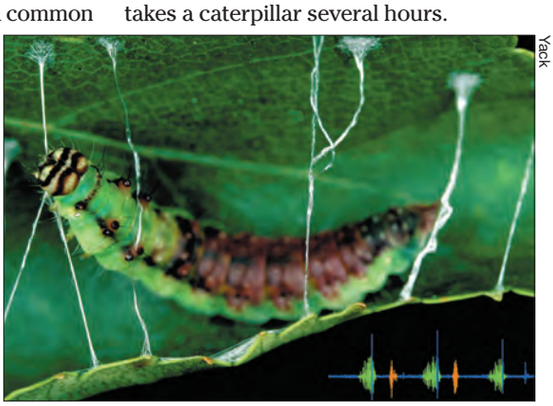
In the third study, scientists gave irbesartan or a placebo to 590 patients with traces of albumin in their urine, a trait that's been linked to later kidney failure. After 2 years, patients receiving the larger of two dosages of irbesartan were about one-third as likely as those on placebos to develop significantly higher concentrations of albumin in their urine, a sign of kidney problems, reports study coauthor Hans-Henrik Parving of the Steno Diabetes Center in Gentofte, Denmark.

In response to these studies, regulators should consider permitting manufacturers to label the drugs as treatments for diabetes patients with high blood pressure and early signs of kidney damage, says Thomas H. Hostetter of the National Institute of Diabetes and Digestive and Kidney Diseases in Bethesda, Md. —*N. Seppa*

Shhh! Is that scrape a caterpillar scrap?

A series of staged insect spats reveals the first known acoustic duels of caterpillars.

Larvae of the hook-tip moth, a common resident of birch and alder trees in the northeastern United States, spin silk stitches to create folded-leaf retreats, explains Jane Yack of Cornell University. Should another caterpillar have the impertinence to wriggle too near the masterpiece, an exchange of leaf-scraping and drumming breaks out. The insects use the drumming—so loud a person can detect it several meters away—to compete for territory without violence, Yack and her colleagues report in the Sept. 25 PROCEEDINGS OF NATIONAL ACADEMY OF SCIENCES.



Yack

A hook-tip moth caterpillar spins silken strands to fold a leaf into a retreat.

Scientists too often dismiss caterpillars as "eating machines," Yack grumbles. Although naturalists have published the occasional report of noise from various species of caterpillar, previous studies focused on sounds from species that lure ants to serve as bodyguards.

The work with hook-tip-moth larvae represents the first analysis of caterpillar-to-caterpillar conversation, she says, and it gets pretty sophisticated for simple leaf crunchers. "This is exciting because it's opening the door to what caterpillars are saying," she says.

Yack was rearing caterpillars to expand her earlier studies of insect hearing (SN: 1/22/00, p. 54) when she heard ticking sounds. "I thought it was the refrigerator at first," she says. However, recordings of airborne and leaf vibrations confirmed that the scraping and taps came from solitary larvae of the hook-tip moth, *Drepana arcuata*.

When they hatch, the 2-millimeter-long caterpillars share a communal shelter. As an older, centimeter-long larva, each seeks a leaf of its own. Doubling over part of the leaf and fastening it with silk takes a caterpillar several hours.

Yack and her colleagues staged 53 invasions of occupied leaves. As the intruder approached, the resident tapped and scratched with its mouth parts and with a pair of oarlike projections on its rear.

Intruders scraped and drummed, too, but they usually retreated within minutes, the researchers report. When Yack replaced a resident with a squatter, it typically drummed up a storm and retained possession when the original home builder tried to return.

Caterpillar anatomy suggests that the larvae respond to vibrations of a plant rather than airborne sounds, Yack notes.

Another student of insect vibrations (SN: 3/21/01, p. 190), Rex Cocroft of the University of Missouri in Columbia, calls the work a "lovely study." Because researchers can hear the dramatic choruses of crickets, katydids, and other users of the airway, that's what they first investigated. "The proportion of the insect world using airborne sounds is just the tip of the iceberg," he says. —*S. Milius*

Youthful nicotine addiction may be growing

The proportion of teenagers and young adults who smoke cigarettes daily has declined in the United States over the past 20 years, thanks in no small part to a public health campaign to discourage tobacco use. At the same time, however, nicotine addiction has widened its grip among those young people who do smoke, a new study finds.

Daily cigarette smokers aren't necessarily hooked on nicotine. But for people ages 24 and younger, the rate of addiction among regular cigarette smokers has increased even as the overall popularity of smoking has dropped, reports a team led by psychologist Naomi Breslau of Henry Ford Health System in Detroit.

"There is reason to worry about these findings," Breslau says. "Nicotine dependence makes it much harder for a person to quit smoking cigarettes."

Her investigation, published in the September ARCHIVES OF GENERAL PSYCHIATRY and based on data collected in 1992, provides the first national data on nicotine-dependence rates. Other studies, such as the annual Monitoring the Future survey of drug use among U.S. teens and young adults, examine daily cigarette use but not nicotine dependence.

Since 1987, the American Psychiatric Association's manual of mental disorders has listed nicotine dependence as a form of drug dependence. Cardinal signs include an inability to control cigarette use, distress at not being able to quit, and harsh withdrawal symptoms in the absence of nicotine use.

Critics argue that this diagnosis wrongly treats a behavioral problem as a medical illness. But if the new findings hold up, they'll highlight the overlooked need for physicians to treat teenage nicotine dependence, remarks psychiatrist John R. Hughes of the University of Vermont in Burlington.

Breslau's group analyzed data on tobacco use and nicotine dependence for a national sample of 4,414 people, ages 15 to 54. This survey was part of a government-funded study of mental disorders.

Half the volunteers reported having smoked cigarettes every day for a month or more sometime in their lives. One in four smokers had become addicted at some point. Symptoms of this dependence usually didn't emerge until at least a year after daily cigarette use had begun, the researchers say.

Nicotine-dependence rates for daily smokers didn't vary between males and females or between those with little and lots of education. However, black cigarette smokers reported less nicotine dependence than their white counterparts.

The lowest incidence of daily cigarette use—reaching about 36 percent—occurred among 15- to 24-year-olds. This figure rose in successive age groups to a peak of 60 percent among 45- to 54-year-olds.

In contrast, daily smokers in the youngest age group exhibited a stronger tendency to become addicted than their older counterparts. For those young smokers whose daily cigarette use had lasted 6 years, for example, nicotine dependence rates hit 60 percent. Only 10 percent of the corresponding group of 45- to 54-year-olds had ever been addicted.

Breslau's team now will examine data for young people who have completed the same surveys since 1992. If the same results emerge, she says, scientists will need to expand efforts to identify biological and social factors that boost susceptibility to nicotine dependence.

A rise in nicotine dependence among young cigarette smokers wouldn't surprise Jerald G. Bachman of the University of Michigan in Ann Arbor. Cigarettes are among the most dependency-producing substances, says Bachman, a codirector of the Monitoring the Future surveys. Despite the overall downturn in the past 2 decades, he notes, rates of daily cigarette smoking by young people have risen slightly in the past few years.

—B. Bower

Alcohol on your breath need not be all bad

Police today can check whether people have been drinking by smelling their breath. In the future, a person might have a good excuse for giving off the aroma of alcohol—a doctor's prescription.

Buoyed by a study in rats, Massachusetts scientists suggest that people with diabetes or other chronic diseases may someday forgo frequent injections of medicine such as insulin and instead inhale a drug-carrying alcohol mist.

"It's a new concept that merits exploration," says John Patton of Inhale Therapeutic Systems in San Carlos, Calif.

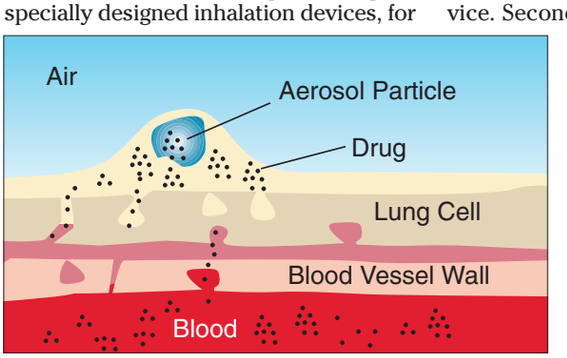
Since most people hate injections, pharmaceutical firms strive to develop medicines that can be taken as pills. Yet insulin, which controls people's blood sugar, and many other drugs are large proteins that break apart during a trip through the digestive system.

Alternative forms of drug delivery, such as nasal sprays and skin patches, often don't get enough medicine into the blood. In contrast, the lungs offer ready access to the bloodstream because they routinely pour oxygen into it.

"The opportunity of delivering drugs through the lungs is just huge," says Anthony J. Hickey of the University of North Carolina at Chapel Hill.

Most researchers have focused on transforming dry powders or water-based drug solutions into aerosol particles small enough to penetrate deeply into the lungs. Yet each of these drug formulations has several limitations.

Powders tend to clump and require specially designed inhalation devices, for example. "Historically, it's been difficult to disperse them efficiently and reproducibly," says Hickey.



Deep in the lung, drug particles from an alcohol aerosol quickly reach the blood.

On the other hand, water solutions are open to microbial contamination and contain far smaller concentrations of a drug than powders do. Also, proteins may degrade in water over time.

Proteins suspended in ethanol, the form of alcohol in beer and wine, may offer a third option for inhalation therapy, Alexander M. Klibanov of the Massachusetts Institute of Technology and his colleagues report in the Sept. 25 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

"Ethanol has some advantages," notes Klibanov. First, the chemical has sterilizing properties that should prevent microbial contamination of an inhalation device. Second, proteins generally remain stable in ethanol.

To test their concept, the investigators added insulin to ethanol and showed that rodents inhaling a mist of the mixture experienced a drop in blood sugar concentration. The rats responded as well as rodents inhaling aerosols from a powder or a water solution did.

A series of tests indicated that the alcohol aerosol hadn't damaged the rodents' lungs, says Klibanov, but the long-term safety of alcohol-inhalation therapy needs further study. The strategy wouldn't deliver enough ethanol to intoxicate anyone, he says.

Neither Klibanov nor the other researchers expect ethanol suspensions to completely replace powders or water solutions in inhalation therapy, but they say it may offer the best option for some drugs.

"Anything that's new and different can only help the field," says Hickey. *—J. Travis*

When Branes Collide

Stringing together a new theory for the origin of the universe

By RON COWEN

For an eternity, our universe lay dormant—a frozen, featureless netherworld. Then, about 15 billion years ago, the cosmos got an abrupt wake-up call.

A parallel universe moving along a hidden dimension smacked into ours. The collision heated our universe, creating a sea of quarks, electrons, protons, photons, and other subatomic particles. It also imparted microscopic ripples, like ocean waves crashing on a shore.

These ripples generated tiny fluctuations in temperature and density, the seeds from which all cosmic architecture—from stars to gargantuan clusters of galaxies to galactic super clusters—ultimately arose.

This model for the evolution of the cosmos, first presented at a cosmology meeting at the Space Telescope Science Institute in Baltimore last April, has been widely discussed and debated ever since. Although the hypothesis sounds like science fiction, some scientists say it's the first serious challenge to the reigning model of the birth of the universe.

According to the standard theory, the universe was born some 15 billion years ago in a hot, expanding fireball, an event scientists call the Big Bang. The universe then underwent a brief spurt of faster-than-light expansion, called inflation, before settling down to the much slower, steady expansion observed today.

"After many years in which we had a single model—[the Big Bang combined with] inflation—for the universe's beginning, we now have an alternative," comments theorist Mario Livio of the Space Telescope Science Institute, one of the organizers of the April meeting on this topic.

"The reason that this is important is that in spite of its attractive features, inflation theory has not been tested observationally in any detail," he notes. Livio adds that the new model "provides us with a potential true test that can distinguish between it and inflation."

"I don't think it's by any means yet a real rival to inflation, but I think it is a model well worth pursuing," says Alan H. Guth of the Massachusetts Institute of Technology, one of the developers of the inflation model.

Despite its name, nothing goes bang in the Big Bang theory. The cataclysm it proposes wasn't anything like a bomb exploding into preexisting space, since all space was contained inside the infant universe. Rather, the Big Bang refers to the event when the immense energy in the infant universe drove it to expand.

In the new hypothesis, however, "our universe begins in a static, featureless state" that persisted for eons, notes Paul J. Steinhardt of Princeton University. That dormant period may have lasted a hundred trillion trillion years. Then, there really was a bang—a giant collision that heated the cosmos to a high temperature. This collision sparked the steady expansion of the universe, and over time, gravity molded gas clouds into stars and galaxies—equivalent to what happens in the widely accepted Big Bang scenario.

To generate that all-important collision, the new model presupposes hidden dimensions and myriad universes floating through space like parallel plates. By chance, one of those plates whacked into the one destined to become our universe.

"It's a very radical idea we have," admits Burt A. Ovrut of the University of Pennsylvania in Philadelphia. "The old idea was that the universe started out at some time zero and ballooned outwards in a burst of inflation. We're now proposing that 'time zero' was just a marker, that the universe really existed long before that."

Steinhardt, Ovrut, and their colleagues Justin Khoury of Princeton and Neil Turok of the DAMTP in Cambridge, England, call their model the ekpyrotic universe, from the Greek word for conflagration.

"We might have used the term 'Big Bang', but that name was taken," jokes Ovrut.

If a theory ain't broken, why fix it? Even in its most primitive form, which does not include inflation, the Big Bang theory correctly predicts the cosmic abundance of helium and deuterium and the temperature of the radiation left over from the birth of the universe.

The classical Big Bang picture was first proposed in the late 1920s. Two decades ago, researchers realized that the scenario needed to be modified.

In its original form, the model would lead to a universe vastly different from the one we live in. For instance, the theory doesn't provide a way for stars, galaxies, and larger structures to arise, notes Steinhardt. Moreover, the Big Bang model would tend to produce a cosmos whose composition and density would vary widely from place to place and whose overall geometry would be warped or curved.

That's in stark contrast to numerous observations, which reveal a universe that is the same, on the large scale, in all directions and has just the right amount of matter and energy to keep it perfectly flat.

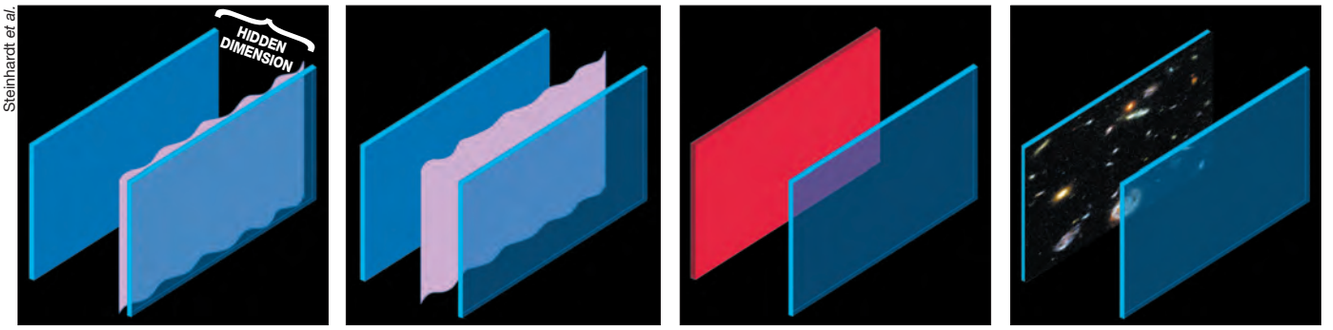
In 1980, Guth amended the Big Bang theory to account for these discrepancies. Refined by several researchers over the past 2 decades, Guth's model posits that the infant cosmos underwent a brief but enormous episode of inflation, ballooning at a rate faster than the speed of light. In just 10^{-32} seconds, the universe expanded its girth by a factor of about 100 trillion trillion, more than it has in the billions of years that have elapsed since.

The inflation model accomplishes several feats (SN: 12/19&26/98, p. 392). It explains why widely separated parts of the universe—regions so far apart that all communication between them is impossible—can nonetheless look as similar as the closest of neighbors. Inflation theory suggests that when the universe began, these regions were indeed neighbors and then rapidly spread far apart.

Inflation also makes the universe flat. Any curvature to space-time would have been stretched out by this era of faster-than-light expansion.

Furthermore, the ballooning would have provided a way for chance subatomic fluctuations in the early universe to inflate to macroscopic proportions. Over time, gravity could then have molded these variations into the spidery network of galaxies and voids seen in the universe today.

The Big Bang model combined with inflation matches several important observations, including the detailed structure of the radiation called the cosmic microwave background, which is left over from the universe's birth. Data gathered by several balloon-borne and ground-based



Steinhardt *et al.*

In the ekpyrotic model, our universe is represented as a three-dimensional membrane embedded in a five-dimensional surface. That "brane" (blue at left) is known as a boundary brane because it lies at one boundary of the fifth dimension. Another boundary brane lies some distance away, on the other side of the fifth dimension. In one version of the model, a brane (violet) peels off the distant boundary brane and collides with the brane destined to become our universe. The energy imparted from this Big Crunch ignites the Big Bang (red) and sets the stage for the formation of the galaxies seen in the universe today.

telescopes fit the predictions of the inflation model (SN: 4/28/01, p. 261).

Yet some cosmologists view inflation as a mysterious, ad hoc device. For instance, notes Steinhardt, no one knows what type of force triggered the onset of inflation or what ended it. "We've been searching for several years to find either a more natural way of incorporating inflation or an alternative model based on new physics," he says.

Inflation, Steinhardt says, is based on quantum field theory, which views every elementary particle as a point-like object. In the past decade, however, physicists have begun thinking about elementary particles in a new way, based on a model called string theory.

According to this view, electrons, quarks, and all the other elementary particles in the universe behave as point particles when observed at a distance, but each is actually composed of tiny loops or strings of energy. The different vibrations of a string, like the different notes that can be plucked on a violin, correspond to different particles.

"It's a beautiful idea because it says that all of the particles we see actually arise from a single object—string," says Ovrut.

Each string vibrates in a space-time that has 11 dimensions—7 dimensions beyond the usual 3 of space and 1 of time (SN: 2/19/00, p. 122). The newest twist on string theory, dubbed M theory, allows for more-complex objects: surfaces rather than just strings. These surfaces are known as membranes, or just branes.

Many physicists are studying branes in the hope of linking gravity and the other fundamental forces of nature to the elementary particles that communicate these forces. According to Steinhardt and his colleagues, certain types of branes may turn out to have profound consequences for cosmology.

Instead of working with the 11 dimensions implied by M theory, the researchers have focused on branes that exist in 5 dimensions. In this model, the other 6 dimensions are tightly curled up and can be ignored. Certain branes that exist in this abstract five-dimensional space can be represented by infinitely long, parallel planes and seem to have a close correspondence to our universe.

In this construct, our cosmos could have plenty of company. Other would-be universes—also represented by branes—may be floating through the fifth dimension. These branes would remain invisible because particles and light can't travel through the fifth dimension. However, gravity can couple matter across that dimension, and collisions between branes are possible.

In the ekpyrotic scenario, the fifth dimension is finite in size and bounded on either side by a three-dimensional brane. One of these boundary branes was the surface that was to become our own cosmos, and the other represents another universe. In the version of the theory first described last April, a third brane peels off the opposing boundary brane and bangs into ours. In the collision, it melds with our brane, igniting the Big Bang.

"There is a certain sense in which this is like two pieces of putty slamming into each other and heating up," says Ovrut.

Critics of the scenario, as well as Steinhardt's team, have noted that the universe created by the impact contracts rather than expands. If so, it wouldn't have generated a cosmos like ours.

In a modified version of the ekpyrotic theory, posted Aug. 26 on the Internet (http://xxx.lanl.gov/abs/hep-th/0108187), Steinhardt, Nathan Seiberg of the Institute of Advanced Study in Princeton, N.J., and their collaborators say such concerns are now unwarranted. According to their calculations, the new model can produce a collision without having to rely on one invisible brane peeling off from another.

Instead, one of the boundary branes moves slowly but steadily toward the other, attracted by an exchange of lower-dimension branes between the two. As the boundary brane moves, it shrinks the fifth dimension. When the two boundary branes touch, the fifth dimension collapses completely, an event the researchers call the Big Crunch.

As in the earlier version of the theory, the collision triggers the Big Bang. However after the impact, the two boundary branes bounce off each other and move apart, recreating the fifth dimension. This rebound starts the expansion of our universe.

In either version of the theory, the laws that govern elementary particle physics require that the boundary branes be flat as a pancake before they collide and that they stay that way afterwards. Consequently, the universe generated by the collision is flat. An episode of inflation isn't needed to stretch out any curvature since none ever existed.

Because the impact is so uniform—exactly the same force is applied up and down the flat boundary between the two branes— widely separated parts of the universe get the same kick and thus evolve in exactly the same way after the collision. This accounts for the uniformity of distant reaches of the cosmos without having to invoke an episode of inflation.

Due to quantum effects, which make the boundary between the branes slightly uneven, some parts of our brane would be struck ever so slightly earlier or later than other parts. This would create tiny temperature differences within the struck brane that, like those in the standard Big Bang model, become the seeds for galaxy formation. The collision also causes the brane to stretch or expand, accounting for the expansion of the universe observed today.

The researchers "make a graceful transition from the Big Crunch to the Big Bang," says David N. Spergel of Princeton University. "This is arguably a 'new ekpyrotic universe' that appears to be more elegant than the old model."

According to Steinhardt, the ekpyrotic theory does everything that Big Bang plus inflation accomplishes. "It's just that we happened to discover one theory first—20 years ago," he says.

"What [the ekpyrotic theory] has going for it is a much closer relationship to

string theory than any formulation we currently have of inflation," says Guth. "String theory is simply the only hope we currently have for a quantum theory of gravity, and obviously gravity has to be quantized to be consistent with the rest of what we know about physics."

Nonetheless, "I'm still somewhat skeptical about the whole thing," Guth adds. "They need to make very strong assumptions about the initial conditions—they're really starting out with a universe that's already infinite and uniform."

Another developer of the inflation model, Andrei Linde of Stanford University, takes a much dimmer view of the new work and has posted several papers on the Internet lambasting the ekpyrotic model. He says that to produce galaxies, Steinhardt and his colleagues have to choose a highly specialized, unrealistic form of interaction between branes. Moreover, Linde claims that the branes in the ekpyrotic model are not truly uniform in structure and therefore can't account for the large-scale uniformity of the universe.

"Instead of a theory, we have only wishful thinking," he says.

Steinhardt and his colleagues have posted responses on the Internet.

Making a universe in ekpyrotic theory requires patience, notes Ovrut. Because the attractive force between branes is so small, they move at a snail's pace, and it could take an extraordinarily long time for a collision to occur, he says.

In effect, says Ovrut, the new theory replaces the very short growth spurt of inflation with a very long lead time for a collision.

As a bonus, he notes, the collision described by ekpyrotic theory not only generates cosmic structure, it also creates the known families of quarks and other fundamental particles.

"What's very beautiful about these brane models is that one can actually compute the spectrum of [elementary] particles, and what you get is something like our real world," notes Ovrut.

At least one empirical test of the ekpyrotic theory may soon be possible. The test would examine gravitational waves, the radiation produced when massive objects accelerate.

Big Bang plus inflation predicts that gravitational waves can have extremely long wavelengths, while the ekpyrotic theory does not. Long-wavelength gravitational waves would leave a distinctive fingerprint on the cosmic microwave background.

Future experiments with a new generation of space, balloon-borne, and ground-based telescopes may be able to detect that fingerprint, says Ovrut.

Other aspects of the ekpyrotic model are still being scrutinized.

"I worry a lot about the details," says Ovrut. "This is a theory that's really still in its infancy." □

Archaeology

Neandertals used tools with versatility

Hand axes. Scrapers. Blades. These and other labels archaeologists put on Stone Age implements imply that ancient people used the tools in specific ways. However, a new study indicates that groups in western Asia used stone implements in more flexible ways, which gave them access to a varied diet of plants and meat over a span of nearly 50,000 years.

The area's prehistoric residents—generally classified by researchers as Neandertals—maintained their versatile stone-tool practices even as major cultural changes rocked the late Stone Age world, according to a team led by Bruce L. Hardy of Grand Valley State University in Allendale, Mich.

Hardy and his collaborator Marvin Kay of the University of Arkansas in Fayetteville used microscopes to analyze 50 stone tools found in the Ukraine. Of the total, 31 had been previously unearthed at a site called Starosele and dated at between 40,000 and 80,000 years old. The remaining 19 implements came from the Buran Kaya III site and have an estimated age of 32,000 to 37,000 years.

These artifacts contain minute clues to their various uses, Hardy, Kay, and their colleagues report in the Sept. 11 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES. For instance, many teardrop-shaped scrapers from Starosele retain wood and starch fragments in grooves near their bases that were part of the binding for handles. Closer to their sharpened tips, these tools display remnants from efforts to process both plants and animals, including geese and other waterfowl.

Large sharpened stone points at Starosele were also attached to handles and probably served as both spears and cutting implements, the scientists say.

Apart from stylistic contrasts in how tools were manufactured at the two sites, microscopic remains and markings on the Buran Kaya III artifacts look much the same as those on the Starosele material, the researchers add.

In their view, Neandertal diets, at least in western Asia, incorporated a wider variety of plants and game than investigators have often assumed.

"This is an important study," comments archaeologist Ofer Bar-Yosef of Harvard University. Microscopic data from the Ukrainian finds underscore the flexibility with which Neandertals employed stone tools, in Bar-Yosef's view. Still, by approximately 30,000 years ago, populations of Neandertals and modern humans had developed distinctive social arrangements and hunting strategies, he theorizes. *—B.B.*

Ancestors who came in from the cold

The Russian Arctic's bitter cold and flat expanses present a formidable challenge to survival. Yet either *Homo sapiens* or Neandertals were living there by around 36,000 years ago, according to a report in the Sept. 6 NATURE.

Until now, excavations had revealed a human presence in the far reaches of northern Asia only as early as 14,000 to 12,000 years ago (SN: 7/7/01, p. 7).

A Russian and Norwegian team, led by Pavel Pavlov of the Russian Academy of Sciences in Syktyvkar, unearthed the remains of an ancient human occupation in riverbed deposits at a Russian Arctic site. Finds include several stone tools, the bones of mammoths and other animals that had apparently been butchered, and a 4-foot-long mammoth tusk bearing signs of being chopped with a sharpened stone. It's unclear why someone made these grooves on the tusk.

Radiocarbon analyses of the marked tusk and three animal bones provided an age estimate for the occupation site.

The new find "implies that either the Neandertals expanded much further north than previously thought or that modern humans were present in the Arctic only a few thousand years after their first appearance in Europe," the scientists say. *—B.B.*

Biomedicine

Obesity linked to pancreatic cancer

Pancreatic cancer strikes obese and sedentary people more frequently than it does thin individuals and those who exercise regularly, a new study finds. The work suggests that some cases of this deadly disease might be avoided by lifestyle changes.

Researchers identified 350 pancreatic cancer patients among a pool of more than 150,000 people who had filled out questionnaires in the 1970s that provided health and lifestyle data.

The researchers had compiled the original data before any participants developed cancer. The scientists later compared the 350 people who eventually developed pancreatic cancer with study participants of similar age and lifestyle who didn't.

The data show that although the overall risk of pancreatic cancer is small, obese people faced a 72 percent greater chance of developing pancreatic cancer than did trim people. The team, led by researchers at the Harvard School of Public Health in Boston, accounted for smoking and other lifestyle choices that might bias results. The study appears in the Aug. 22/29 JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION.

The pancreas produces insulin, which cells need to process sugars. Obese people are often insulin resistant—their cells fail to use the hormone efficiently, leaving an excess of insulin in the blood. Overexposure to insulin in the pancreas could somehow increase the risk of cancer there, says study coauthor Dominique S. Michaud, an epidemiologist currently at the National Cancer Institute in Bethesda, Md.

Exercise, even in moderate amounts, improves sugar metabolism. People who had exercised regularly—by walking or hiking 4 hours per week—faced only half the risk of pancreatic cancer as did those who didn't exercise at all, the researchers found.

The frequency and size of meals also seems to affect risk. People who ate only one major meal per day and ate smaller amounts throughout the day faced about half the risk of pancreatic cancer as did people who ate three major meals per day.

In an editorial accompanying the new study, Susan M. Gapstur and Peter Gann of Northwestern University Medical School in Chicago say the findings suggest that some pancreatic cancers might be preventable. Obesity and inactivity "could account for as much as 15 percent of pancreatic cancer cases beyond those attributable to smoking," they say. *—N.S.*

Constipation might signal Parkinson's

Constipation is a common problem in people who have Parkinson's disease. A new study now suggests that men who have constipation in late middle age are more likely to develop Parkinson's than are those who have more frequent bowel movements.

Between 1971 and 1974, researchers enrolled 8,006 Hawaiian men of Japanese ancestry between ages 45 and 68 in a health study. The scientists recorded the men's health data and then documented their health status again in the 1990s. In the interim, 96 men developed Parkinson's disease.

The researchers found that men who had fewer than one bowel movement per day in the 1970s were nearly three times as likely to develop Parkinson's disease as were men who had averaged one per day, and four times as likely as were men who averaged more than one. These figures accounted for differences due to smoking and other factors, the researchers report in the Aug. 14 NEUROLOGY.

The data don't suggest that constipation causes Parkinson's disease. But the study might permit scientists to identify people at risk of developing Parkinson's, says study coauthor Robert D. Abbott, a biostatistician at the University of Virginia School of Medicine in Charlottesville and the Pacific Health Research Institute in Honolulu. That, in turn, could help researchers designate candidates for experimental treatments designed to protect against the disease, he says. *—N.S.*

Gimme, Gimme, Gimme!

And other bulletins from scientists who study animal begging

By SUSAN MILIUS

A baby bird going "cheep, cheep" as its mommy flies home to the nest may not mystify the casual observer. Little tyke's hungry, wants some fresh worm. What's not to understand?

An original thinker can see the mystery in the mundane, however, and some very original thinkers are asking complex questions about those cheeps.

Perhaps the biggest question has been, Is this a crooked system? For example, might the babe be making that racket to con its parents out of more than its fair share of worm? If so, are its parents devious in return?

Or is this one of the so-called honest signaling systems, in which the cost of making all that fuss keeps the chick and its parents communicating accurately?

These ideas about chick-parent behavior grew out of the study of sexy animal parts, such as a peacock's tail. Such splendid ornaments clearly signal, "Hey, sweetie, be mine." The relative splendor or tattiness of that tail seems to give females an honest signal as to whether the male's a prime catch or a loser. Most birds can't cheat and grow a finer tail than they deserve, biologists find.

Biologists have now set out to see if what they've learned about sexual signaling applies to the calls of begging offspring, not just in birds but in insects, mammals, and even plants**.** The answers concern the evolution of communication: how signals develop, interact with others, and then spread or fade away. All in all, there's been a remarkably large amount of research on whether or not a baby bird cheeps the truth.

In the 1960s and 1970s, genetic studies caught up with the family troubles in "King Lear." Theorists proposed that the modest differences in genes between siblings and between a youngster and either of its parents invite conflicts of interest. A parent, equally kin in genetic terms to each child, might tend to invest equally in the children. Yet each of those little darlings would benefit from sabotaging that equal distribution.

Also from that era came the companion idea that an honest signal between animals, including such anatomical billboards as a peacock's tail, has to cost the signaler something. If any old bird could afford to grow an eye-popper of a tail, then abundant cheating would destroy the value of the signal.

These ideas suggested that babies in the nest have an incentive to manipulate their parents into provisioning them magnificently, even if the effort leaves the parent too worn out to tend to another chick or next season's young. Such conflicts in interest might drive the offspring toward evolving deceptive signals. However, the cost of the begging itself might keep false cheepers in check.

Baby-bird honesty raises three basic questions, according to a 1997 landmark review by Rebecca Kilner and Rufus Johnstone, both of the University of Cambridge in England. First, they asked, does a youngster's need influence the intensity of begging? Next, do parents respond in proportion to begging intensity? Finally, how much does begging cost?

At that time, they found the evidence mixed for each question.

The answer to the first question now seems to be yes, according to Marty Leonard of Dalhousie University in Halifax, Nova Scotia. She has reviewed recent findings while editing a book on begging, due out next year.

Tests in the mid-1990s, for example, showed that pigeon nestlings that had been recently fed didn't spend as much time begging as those that researchers had stinted. Likewise, food-deprived yellow-headed blackbirds called at a faster rate and called longer when they'd missed a meal than when they'd been fed on schedule.

Eggs beg too, it seems. Little noises come from white pelican eggs, and if the temperature falls just before hatching, the egg noises can speed up. Just like begging for food, these chirps for warmth intensify as the egg chills.

Chirping after hatching earns a chick a snuggle under a nice warm parent, so researchers propose that rapid chirps from eggs get them warmed, too.

For the second question—whether parents respond to a rising frenzy of begging—some experiments have indicated that the answer also may be yes, Leonard says. Pigeons dole out food to their brood in proportion to the youngsters' begging. Furthermore, tests in canary nests found that parents give more nourishment to food-deprived chicks.

One study of red-winged blackbirds failed to find any effect from intensified chick begging, but a more recent experiment did. In that test, reported in 1998 by Julie E. Burford and her colleagues at Beloit (Wis.) College, red-winged blackbirds delivered extra food to their nestlings when researchers enhanced the begging cacophony by broadcasting recorded chick calls for 5 minutes. However when researchers played white noise for 5 minutes, the parents didn't rush in any more food than when the nestlings squawked unassisted.

Tracking responses to different kinds of calls, Leonard and her collaborator Andrew G. Horn of Dalhousie University compared the power of begging squeaks from tree swallow nestlings that had been deprived of a meal or had been recently fed. The hungrier nestlings called more rapidly and frequently. Parents tended to make the first offer of food to a fake nestling near a speaker broadcasting the deprived-chick's call rather than one putting out a better-fed chick's call. The parents also made more total attempts to feed the fake chick with the deprivation call, the researchers reported in the January BEHAVIORAL ECOLOGY AND SOCIOBIOLOGY.

The researchers did a second experiment to work out just what made that hungrier chick's call so compelling. After electronically tweaking the calls in various ways and broadcasting them to parents, Leonard and her colleagues concluded that faster and more-frequent calling won extra attention from parents. Just getting louder didn't work.

In a different comparison of parental response, Nicola Saino of the University of Milan in Italy and her coworkers examined begging—this time from real barn swallow nestlings—linked to short-term or long-term troubles. The scientists created a short-term need by keeping otherwise healthy nestlings from getting a meal. For a longer-term problem, the researchers challenged a chick's immune system by injecting a foreign substance.

Parents tended to favor chicks with either difficulty, giving them a bigger share of the food than they gave less troubled siblings. Nestlings with neither short-term nor long-term troubles had to make do with less parental attention, the researchers reported in the December 2000 AMERICAN NATURALIST.

Feeding responses aren't just a bird thing. The meerkat, a kind of African mongoose that raises pups cooperatively within a group, also seems to succumb to the power of begging, Marta B. Manser of the University of Pennsylvania in Philadelphia reported in the November 2000 BEHAVIORAL ECOLOGY AND SOCIOBIOLOGY.

Meerkat pups don't stay in a nest but tag along after an older group member for hours at a time. As the older forager explores, the trailing pup or pups call repeatedly. Should the lead meerkat locate a tasty scorpion or other invertebrate, a nearby pup switches calls, bleating faster, louder, and with a higher frequency. Watching meerkats and experimenting with recorded calls convinced Manser that pups pleading louder and more intensely got more of the bounty than less vocal youngsters did.

The last of the three questions—whether begging takes a toll on offspring—has proved to be the messiest issue. Leonard says that the metabolic demand of begging has proved relatively modest—less than 1 percent of the energy budget.

Nestlings may look hungry, but are they telling the truth?

But researchers wonder whether begging incurs other costs. It might raise such a ruckus that it provokes attacks by predators.

Field experiments haven't revealed clear-cut results. For instance, predators molested fake western bluebird nests at ground level more often when the nests were broadcasting begging calls than when they were silent. Yet when the researchers put the nests in trees, they found no clear difference in attacks on noisy and quiet nests.

Additional questions are emerging. For example, can begging animals learn especially good ways to whine, much as babies discover the most effective ways to manipulate their parents?

The answer to that one may be an emphatic yes, according to Hilla Kedar's experiments hand-rearing house sparrows. She and her colleagues fed chicks only when they begged at a certain instensity, and the nestling house sparrows needed only a few hours to find the begging levels that got them the most goodies. Kedar, who's at Tel Aviv University in Israel, described the work in the September 2000 PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON B.

Another issue is what to make of infants that squawk even when there's no parent nearby. That's the case for at least 15 percent of the begging calls from the southern grey shrike, noted Amber E. Budden at University of Wales in Bangor in the May BEHAVIORAL ECOLOGY AND SOCIOBIOLOGY.

Nestling barn owls have all-chick squawkfests, too. Alex Roulin of the University of Bern in Switzerland proposed last year that with no parents around, the young owls appear to settle who'll get the goods when Mom or Dad does arrive. In Roulin's observations, at the actual dishing out of food, a nestling refrained from vocalizing if it had been fed more recently than a sib. Once that needy case was fed, however, the formerly restrained nestling started yakking.

Other researchers are looking at a variety of ways in which one chick influences the begging of its siblings.

Fights as well as begging can influence the parents' food appropriation, reported Bonnie J. Ploger of Hamline University in St. Paul, Minn., at the Animal Behavior meeting last July.

Her research team put Plexiglas dividers into notoriously raucous egret nests so all the chicks could see each other and get food from their parents but couldn't touch each other. A hand warmer was tucked into each chick's partition to prevent chills. To ease the disruption they caused, the researchers took down the entire assemblage at the end of each research day so parents could warm the nest at night.

Egret parents brought home the same total amount of food regardless of whether or not the researchers had partitioned the nests. The partitioning did change the food distribution, however. The alpha chick, the oldest and brawniest, got the biggest share of food when it was free to beat up its siblings, but it snagged only a bottom-ranker's measure when partitions stopped the fights.

Without those fights, the second-ranked chick rocketed to the top of the food chain. Its mother preferentially gave it food, but its father showed no such favoritism. Ploger proposes that female egrets may have a built-in susceptibility to begging from chick number two.

A fundamental question has emerged from recent work: What's a begging signal? Many of the experiments to date have relied on sounds, but creatures communicate over various channels.

One is sight. When patches on the head of a young Western grebe flush red, parents seem more likely to feed the chick. Warbler parents, too, seem to select chicks for feeding according to the color. The hue of the chicks' gaping mouths varies with each young bird's immune condition.

Larval burying beetles also beg visually, making a waving motion when their parents appear. When parent beetles lay eggs, they provide a dead animal to nourish the young. As the eggs hatch and larvae grow, the parents feed their brood with regurgitated carcass.

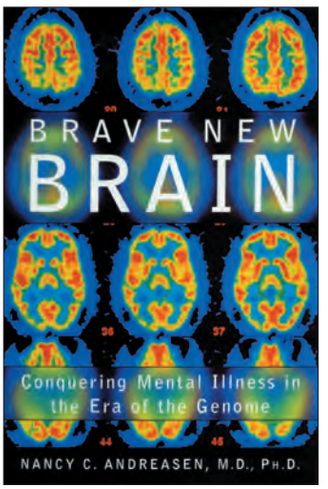
When a female dart-poison frog hops up to the little pool where one of her offspring is growing, the tadpole usually starts swimming around. Mom lays eggs in the pool, which the tadpole gobbles. Does the tadpole's swimming a couple of laps signal either its need or worthiness for food?

Other senses may prove important, too. Baby ageienid spiders stroke their mother's mouthparts, and she regurgitates food for them. Is that tactile begging? And as seeds form in plants, they synthesize hormones that start the flow of resources from maternal tissue. Is this begging by chemistry?

For inquiring minds, that initial "cheep, cheep" is proving very rich. □

Nancy Andreasen, a leading neuroscientist who is editor-in-chief of the AMERICAN JOURNAL OF PSYCHIATRY, offers a state-of-the-art look at what scientists know about the human brain and the human genome—and shows how these two vast branches of knowledge are coming together in a bold, ambitious effort to conquer mental illness.

Scientists today know more about the brain than ever before, thanks to new imaging techniques and to discoveries in neuroscience and molecular biology. Andreasen gives us an engaging and readable description of how it all works. She also shows the progress made in mapping the human genome.



Oxford University Press, 2001, 6¼" x 9½"
368 pages, hardcover, $29.95

In perhaps the most fascinating section of the book, we read gripping stories of the people who develop mental illness, the friends and relatives who share their suffering, the physicians who treat them, and the scientists who study them so that better treatments can be found. This section covers four major disorders—schizophrenia, manic depression, anxiety disorders, and dementia—revealing what causes them, what happens to the mind and brain, and how the illnesses are treated. Finally, the book shows how the powerful tools of genetics and neuroscience will combine during the next decades to build healthier brains and minds.

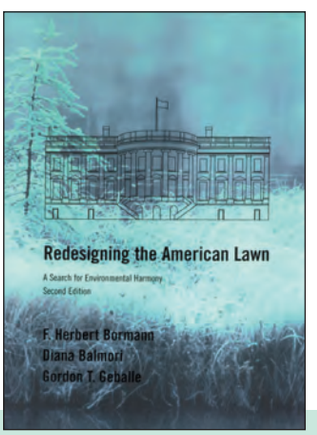
—from Oxford University Press

"Conventionally maintained lawns are sterile, unhealthy habitats that consume time and precious resources and poison watersheds. This classic book, updated and in a new format, provides an essential foundation for a new culture of conservation starting at home."

—Frank Gill, Senior Vice-President for Science, National Audubon Society

Americans enthusiastically plant, weed, water, spray, and mow 31 million acres of a lawn. But is our dedication to these lawns contributing to the serious environmental problems facing the planet? The authors of this book argue that it is, and they offer strategies for creating and caring for aesthetically pleasing and ecologically sound lawns. This new edition, a reissue in a more artistic format and with many additional illustrations, updates the original text and adds a chapter showing what progress has been made in the ecological management of landscapes over the past decade.

—from Yale University Press



Yale University Press, 2001, 178 pages
7" x 9 ½", paperback, $16.95

Earth Science

Himalayas may be due for big temblors

A narrow region along the southern edge of the Tibetan Plateau could be the spawning ground for earthquakes that threaten millions of people in southern Asia in decades to come, scientists warn.

Global Positioning System measurements show that the Indian subcontinent is crashing into Asia at a rate of about 20 millimeters per year, or 2 meters per century. About 80 percent of the energy of that collision is absorbed by rocks and fault zones in a 50-kilometer-wide band that runs along the northeastern border of India through the Himalayas, the so-called Himalayan arc, says Roger Bilham, a geophysicist at the University of Colorado at Boulder. The area around the arc absorbs the other 20 percent.

Nearly all of the energy accumulating in and around the mountains will eventually be released in earthquakes, according to an analysis by Bilham and his colleagues.

In 1905, 1934, and 1950, temblors measuring more than 8.0 on the Richter scale rocked separate parts of the Himalayan arc. Each occurred along existing faults between 100 and 300 km long. In each quake, the sides of these faults slipped about 4 m relative to one another, releasing 2 centuries' pent-up energy.

On the other hand, those three great quakes relieved the stress along only one-fourth of the Himalayan arc, says Bilham. The remainder of the region hasn't experienced a major quake in more than 300 years. This means that the faults in those areas have stored enough energy to cause temblors at least as large as those suffered last century. Bilham is quick to note that he and his colleagues aren't forecasting when or where along the Himalayan arc a major earthquake might occur.

"You can't stop these earthquakes," says Bilham. "You can only hope to mitigate their effects." He and his colleagues report their findings in the Aug. 24 SCIENCE.

India's population has doubled since the Himalayan earthquake of 1950. About 50 million people—including residents of the capital cities of Bangladesh, Bhutan, India, Nepal, and Pakistan—are at risk from similar temblors today. Bilham's team estimates that if a magnitude-8.0-plus earthquake occurred near one of the larger cities in the area, it could kill around 2 million people. —*S.P.*

Quantum physics explains core anomaly

Scientists have used the principles of quantum physics to answer a long-standing puzzle: How can seismic waves travel at different speeds in different directions through Earth's inner core?

The velocities of seismic waves going north-south through the center of Earth are slightly faster than those traversing the core in an east-west direction. On average, however, the travel times of these waves indicate that the planet's inner core is made of iron that has a density of about 13 grams per cubic centimeter. That's about double iron's density at the less hellish temperatures and pressures of Earth's surface.

In Earth's core, iron atoms pack together and make crystals in the shape of hexagonal prisms, says Gerd Steinle-Neumann, a geophysicist at the University of Michigan in Ann Arbor. Thermodynamic equations that incorporate the quantum behavior of iron atoms under high pressures show that vibrations travel at a different speed across the hexagonal crystals' cross sections than along their axes, he notes.

Most geophysicists have assumed that the crystals in the core have random orientations. The observed mismatch between seismic waves traveling north and south and those traveling east and west, however, can be explained if the cross sections of about one-third of the hexagonal iron crystals in the core are aligned with Earth's rotational axis. Such an alignment could result from external forces such as Earth's magnetic field, Steinle-Neumann says. Bilham and his colleagues report their finding in the Sept. 6 NATURE. —*S.P.*

Technology

Futuristic engine proves its mettle

Proponents of exotic aircraft engines called scramjets say the technology might eventually make it possible to reach any spot on Earth in a 2-hour flight (SN: 9/19/98, p. 182). Yet, in more than 40 years of development, no scramjet-driven craft has ever made even a short hop under its own power.

Now one has—but just barely.

On Aug. 27, the Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced that DARPA-funded researchers at the company GASL, in Ronkonkoma, N.Y., had achieved the milestone. A small scramjet-equipped projectile, somewhat like an artillery shell and fired from a cannon, generated enough thrust to overcome air resistance, the agency reported. Instead of slowing down, measurements showed, it maintained a speed of more than Mach 7—seven times the speed of sound.

Allied Aerospace Industries/GASL

Ports around this projectile's nose suck air into its scramjet engine.

By definition, scramjets begin working at about Mach 5. They can exploit shock waves to compress air flowing through the engine, which boosts fuel-burning efficiency.

Previous scramjet tests, which have taken place mostly in wind tunnels or have required external rockets to get them up to the Mach 5 threshold, haven't clearly shown that scramjets actually propel themselves in free flight.

A NASA test in June of the 3.7-meter-long Hyper-X aircraft (also known as X-43A) was to demonstrate scramjet propulsion, but it failed when a rocket malfunctioned.

In the DARPA-sponsored experiment, the titanium, 10-centimeter-diameter scale model of a scramjet missile flew nearly the length of a football field in 30 milliseconds.

"We flew about twice the distance that the Wright brothers did," says DARPA project manager Preston H. Carter, noting that a short hop is sometimes all it takes to demonstrate that a novel type of flight is possible. —*P.W.*

Designing planet rovers that tumble

As soon as 2009, Mars could become a playground for earthlings wielding giant beach balls. The earthlings would actually stay home, but from there they could control 6-meter-diameter inflatable spheres sent to roam the Red Planet.

NASA researchers are currently testing such spheres, dubbed tumbleweed balls, in the Mojave Desert. Counting on Martian winds to blow the balls along, the researchers are hoping that the giant, carbon dioxide–filled balloons will be able to travel much greater distances than wheeled rovers can.

The head of the project, Jack A. Jones of NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif., predicts that the balls could cover thousands of kilometers on Mars. In contrast, the little, wheeled Sojourner vehicle, which arrived on Mars in 1997, wandered no more than a few meters from its lander.

With such an extensive range, the instrument-laden balls could conduct far-reaching X-ray searches for signs of underground water and perhaps life, Jones says. They might also search for variations in magnetic fields in the Martian terrain that could reveal ancient movements of the planet's crust.

Earlier this summer, tests by the JPL team indicated that tumbleweed balls can roll right over meter-tall rocks and climb 25-degree slopes. They are so mobile that the researchers must devise ways to control where the orbs go and when.

One possibility is for mission controllers to partially deflate a ball when it reaches an interesting spot. Another is to shift the position of the heavy payload of cameras and other equipment suspended inside the ball as a way to steer it, Jones adds. —*P.W.*