SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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This Week

Of Note

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Cover At least nine species of North American dragonflies migrate annually. Sometimes, great numbers drop out of the sky, as this individual did, along the New Jersey coast. Migration is one of several frontiers in the study of the familiar insects. (C. Ziegler) Page 104

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Bad Vibrations?

Ultrasound disturbs mouse brains

Prolonged and frequent use of fetal ultrasound might lead to abnormal brain development, a study in mice suggests. The finding sounds a cautionary note for pregnant women getting the commonplace procedure.

In that technique, an ultrasound probe sends high-frequency sound waves into the abdomen of a pregnant woman. The waves bounce back to detectors, creating images of the fetus. Doctors use the pictures to check for birth defects and to assess a fetus' size and movements. Many women also undergo ultrasounds to create collections of early baby pictures.

QUOTE

"Baby pictures aren't a justifiable use for this technology."
VERNE CAVINESS, Massachusetts General Hospital

Ultrasound has generally been regarded as safe. However, a few studies have suggested that it might cause neurological changes, such as delayed speech or an increase in left-handedness. Researchers hadn't studied how the number or duration of ultrasound procedures affects neurons growing in the fetal brain, says neuroscientist Pasko Rakic of Yale University.

Neurons are created in discrete places within the brain as it develops, and they then travel to the brain's outer layers. Rakic and his colleagues study this process, which is known as neural migration.

To determine whether ultrasound affects neural migration, the team worked with mice at a late point in pregnancy, when new fetal neurons have to migrate a long distance to reach the brain's outer layers.

The researchers injected the animals with a chemical that marks newborn neurons and then applied ultrasound to the bellies of some of the animals over the next 3 days. The ultrasound was administered to each pregnant mouse in multiple sessions that totaled 5 to 420 minutes. With the machine turned off, the scientists touched other mice with the ultrasound probe for the same amounts of time. A third group of animals received no procedure at all.

After the mouse pups were born, the team examined brain slices. In animals whose mothers had had ultrasound sessions that added up to 30 minutes or more, the scientists found that a significant number of neurons destined for the brain's outer layers of gray matter had become improperly embedded in inner layers of white matter.

The number of misplaced neurons increased with the total time that a newborn mouse's mother had spent receiving ultrasound. In contrast, the brains of newborns whose mothers had had the sham procedure typically resembled those whose mothers had had no procedure, Rakic's team reports in an upcoming *Proceedings of the National Academy of Sciences*.

"When cells are in the wrong place, they might affect function of the cerebral cortex," which in people controls such higher brain functions as language and movement, says Rakic. "We just don't know yet what this could do."

He and his team plan to conduct studies that will determine whether the results hold up in nonhuman primates.

Rakic cautions that some women might be getting excessive sonography. He's especially concerned about so-called keepsake ultrasounds, which are often performed by untrained technicians in nonclinical settings, such as shopping malls.

The mouse results reinforce guidelines set by the Food and Drug Administration, says pediatric neurologist Verne Caviness of Massachusetts General Hospital in Boston. "The basic guidelines in this country suggest using ultrasound as little as possible," he says. "Baby pictures aren't a justifiable use for this technology." —C. BROWNLEE

Macho Moms

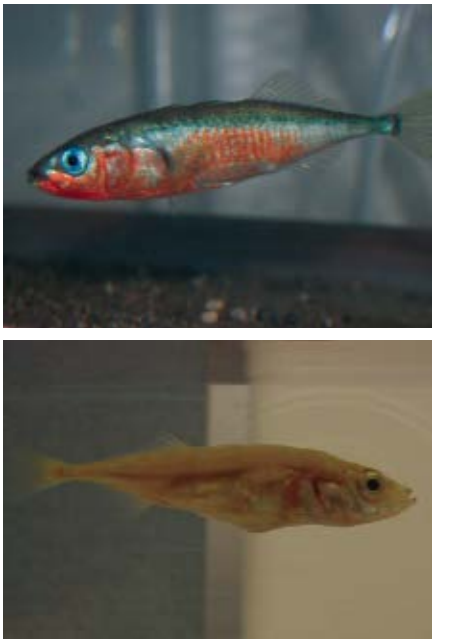
Perchlorate pollutant masculinizes fish

Known largely as a component of rocket fuel, perchlorate is a pollutant that often turns up in soil and water. In dozens of studies, it has perturbed thyroid-hormone concentrations, which can affect growth and neurological development. Data from fish now indicate that perchlorate can also disrupt sexual development.

Some of the changes were so dramatic that scientists initially mistook female fish for males. Several females displayed male-courtship behavior and produced sperm.

Richard R. Bernhardt of the University of Alaska in Anchorage and his colleagues focused on threespine sticklebacks (*Gasterosteus aculeatus*), a tiny marine species. For 3 weeks, the researchers incubated wild-captured adults in clean water or in water treated with 30, 60, or 100 parts per million (ppm) perchlorate. The adults spawned during that period.

Each group's offspring were then raised to sexual maturity in similarly treated or untreated water. At spawning age, 10 apparent males per treatment group were each given their own aquariums. Once a day, each male received a 10-minute visit from an egg-swollen female in the same treatment group.



WHO'S READY? **Bright colors of a wild-captured male threespine stickleback (top) signal that it's ready to spawn. Its perchlorate-exposed nephew (bottom) remains drab and uninterested in mating.**

C. FURIN/UNIV. ALASKA; BERNHARDT/UNIV. ALASKA

The first sign of something amiss: Among perchlorate-exposed fish, many would-be dads lacked the electric-blue and red coloration that normally signals readiness to spawn. Most of these fish didn't exhibit typical reproductive behaviors, such as nest building, and many ignored prospective mates. Among clean-water males, 80 percent spawned. As the perchlorate concentration climbed from 30 to 100 ppm, successful spawning fell from 50 percent to zero.

Eventually, the bellies of three apparent males began swelling with eggs. They proved to be hermaphroditic females, bearing both fertile eggs and fertile sperm.

The perchlorate-exposed true males developed unusually long testes.

Last January, the Environmental Protection Agency suggested limiting perchlorate contamination in natural bodies of water to 24.5 parts per billion. The concentrations used in the new study were at least 1,000 times that limit.

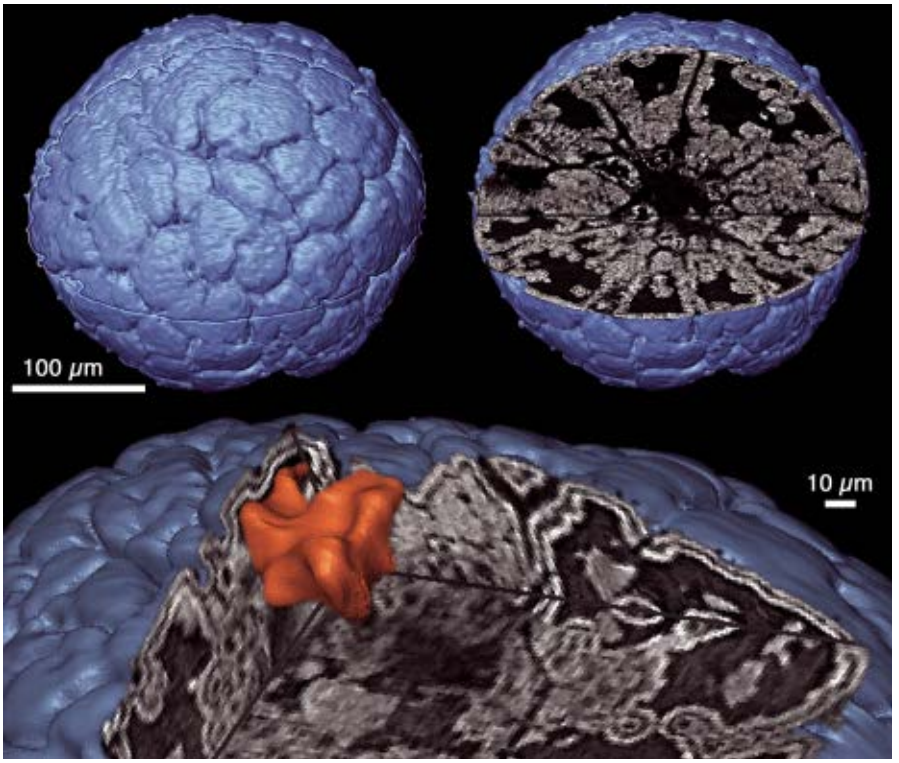
However, these doses are still environmentally relevant, argue aquatic toxicologist Bernhardt and his colleagues in the August *Environmental Toxicology and Chemistry*. They say that the test concentrations are similar to or less than those at several contaminated U.S. sites.

The "big surprise" was that perchlorate could produce hermaphroditic females and males with superlarge testes, says ecotoxicologist Gerald T. Ankley of EPA's Mid-Continent Ecology Division in Duluth, Minn. Clearly, that's "not something you would have anticipated [from] the way we think perchlorate works," he adds.

All the changes observed suggest that perchlorate "is acting like an androgen," or male-sex hormone, notes fish physiologist Ann Cheek of the University of Texas Health Science Center at Houston. Confirming this would require cellular analyses of testes and thyroid tissue.

Christopher W. Theodorakis of Southern Illinois University in Edwardsville argues that the "intriguing" masculinization may instead point to a new role for thyroid hormones—preservation of reproductive function.

"This paper may be telling us there's more to perchlorate—and its effects on the thyroid—than we'd realized," agrees R. Thomas Zoeller, a thyroid endocrinologist at the University of Massachusetts in Amherst. That "could be pretty profound," he says. —J. RALOFF



INSIDE INFORMATION The surface-only view (upper left) of a fossil embryo of *Markuelia*, an ancient relative of marine worms, shows none of the detail visible in a tomographic X-ray image (upper right). The slice at bottom depicts embryonic tissue (white) and a mineral clump (orange).

New View

Method looks inside embryo fossils

Using an X-ray–scanning technique, scientists have taken a high-resolution peek inside fossilized embryos of some of the earliest multicellular organisms. The procedure offers paleontologists a nondestructive way to see what's preserved inside ancient rarities smaller than a pinhead and provides fresh insights into the evolution of life on Earth, the scientists say.

Bones and shells fossilize more readily than an organism's soft parts do, but even delicate tissues such as the multicellular embryos in eggs laid by marine organisms can be preserved under the right environmental conditions (*SN: 1/28/06, p. 56*).

Previously, scientists had either looked at the surface of a fossil embryo that had been extracted from rock or sliced through the specimen to get a cross-sectional view, says Philip C.J. Donoghue, a geologist at the University of Bristol in England. The first technique provides only limited information, and the latter one is time-consuming and destroys the specimen.

"How to analyze and interpret such fossils is a huge controversy," he notes.

Now, Donoghue and his colleagues have used a two-story-tall synchrotron to shoot high-energy X rays into ancient embryos of marine organisms no more than half a millimeter across. The team fired the X rays through each specimen at about 1,000 different angles.

A computer then assembled the X-ray images for each specimen into a single, three-dimensional model that depicts features as small as 1 micrometer across. The researchers describe their technique and findings in the Aug. 10 *Nature*.

When the team scanned the 500-μm-diameter embryo of *Markuelia*, presumed to be a relative of modern marine worms, the scientists could clearly distinguish the difference between fossilized tissues such as cell membranes and mineral clumps that had infiltrated cavities in the embryo. The image revealed an extra pair of appendages on the organism that wasn't visible on the embryo's surface and might have been missed if the specimen had been sliced at the wrong angle, says Donoghue.

The researchers also scanned an embryo of *Pseudooides prima*, an organism that paleontologists haven't classified. That image revealed that an enigmatic groove on the organism's surface extended into the embryo, indicating that the cleft was a biological feature and not a surface defect caused by preservation, says Donoghue.

The odd location of the groove hints that the organism had a previously unknown type of embryonic development, say the researchers. If that were confirmed, scientists could better place *P. prima* near the base of life's family tree.

The detail that can be seen in the fossils with the new method is "quite astonishing," says Derek E.G. Briggs, a paleontologist at Yale University. The technique will prove a boon to interpreting embryonic structures previously hidden, he predicts.

The new findings "add a whole new dimension to understanding the early diversity of fossils," says James W. Valentine, a paleontologist at the University of California, Berkeley. —S. PERKINS

DONOGHUE ET AL

Solar System Small Fry

Stellar blinks reveal tiny bodies near Pluto

By measuring tiny dips in the intensity of X rays from a distant star, astronomers say that they have detected more than 50 of the

tiniest chunks of ice ever found in the outer solar system.

Since 1992, researchers have discovered nearly 1,000 frozen bodies beyond Pluto. All are at least several tens of kilometers in diameter. In contrast, the newfound objects are only 10 to 100 meters in diameter.

These small fry can't be seen with even the world's largest telescopes. Instead, a team led by Hsiang-Kuang Chang at the National Tsing Hua University in Hsinchu, Taiwan, used an indirect technique. The group looked for random, brief drops in brightness of the star Scorpius X-1, the brightest X-ray source in the sky.

Because Scorpius X-1 lies close to the plane in which Earth orbits the sun, millisecond dips in its brightness could be caused by tiny objects at the edge of the solar system passing between it and Earth. The star itself probably doesn't produce such dips, the team notes.

Using data recorded by NASA's Rossi X-ray Timing Explorer over 7 years, the Taiwanese researchers identified 58 short-lived dips in the light from Scorpius X-1. Those dips probably represent 58 previously unknown bodies in the outer solar system, the researchers say in the Aug. 10 *Nature*.

STATS

10^{15}

Number of small, icy objects newly estimated in the outer solar system

Extrapolated from the findings, the total number of objects between 10 and 100 m in diameter in the outer solar system could be as high as a quadrillion, notes astrophysicist Asantha Cooray of the University of California, Irvine, in a commentary accompanying the report. That's a thousand to a million times as many objects in that size range as computer simulations have produced.

The simulations have assumed that small bodies—debris left over from the planet-formation process—initially stuck together to create big objects. Collisions between small and large bodies, which have different speeds, eventually created dust. That dust then either drifted out into space or spiraled into the sun, reducing the population in the outer solar system.

Collisions in the outer solar system may have been less frequent than modelers had assumed, says Cooray. With fewer collisions, a greater number of objects would have remained in that neighborhood.

However, the mismatch between simulations and the new data could simply result from uncertainties in interpreting the X-ray data, the Taiwanese team notes. A small body closer to Earth could produce a dip similar to that of a large body that lies farther away. Although changes in the shape of the dip could, in theory, pin down the distance of the object from Earth, the X rays from Scorpius X-1, though intense, weren't bright enough to reveal those changes.

The evidence for the small, icy objects is convincing, comments planetary scientist David Jewitt of the University of Hawaii in Honolulu. However, given the uncertainties, "no revision [of the structure] of the solar system is needed at this time," he says. —R. COWEN

Total Recall

Drug shows long-lasting boosts of memory in rats

An experimental drug completely regenerates parts of the brain crucial to forming memories, according to researchers who performed tests on rats. Moreover, the drug's effects linger after it clears from a rat's system, so it may lead to a convenient treatment for people with disease-related memory loss, they say.

As people reach age 30, the neural mechanisms that form memories begin to deteriorate. Some diseases accelerate that decline. One strategy to restore this capacity is to increase production of a protein called brain-

Need for Speed

Faster-acting tuberculosis drugs now in testing would limit deaths

Drugs that would take only 2 months to cure tuberculosis instead of the usual 6 months could prevent millions of TB infections and deaths, a new analysis finds.

"It's hard to get people to finish a 6-month course, since a lot of patients start to feel better after a few months," says Joshua A. Salomon, a public health analyst at the Harvard School of Public Health in Boston.

Patients who don't finish the standard treatment fail to wipe out *Mycobacterium tuberculosis*, the microbe that causes TB. They typically survive but are prone to relapses and can remain intermittently contagious, Salomon says.

Scientists are now testing two promising new drugs—diarylquinoline TMC207 and a compound in the nitroimidazopyran family called PA-824. Tests in animals and lab dishes against *M. tuberculosis* indicate that drug therapy with these compounds might require only 2 to 4 months. Both candidate drugs are in early stages of testing in people.

"We're at a point where these new drugs are starting to look like a reality," Salomon says.

He and his colleagues theorized that a drug with a shorter treatment schedule would increase patient compliance, prevent relapses, reduce the development of drug resistance, and ultimately limit the spread of TB because fewer people would harbor the microbe. Moreover, a shorter regimen "would free up resources and enable [health workers] to detect more cases," Salomon says.

He and his team built a mathematical model that considered the various implications of a 2-month cure for TB. The group applied its model to the Asian region that includes India, Bangladesh, Burma, Thailand, and Indonesia.

If made available to the region by 2012, such a regimen would reduce new cases of TB by 20 percent and decrease deaths by 25 percent between 2012 and 2030, the team reports in the August *PLoS Medicine*. That would eliminate 11 million new active cases of TB and would prevent 5 million deaths, compared with the standard treatment, which requires combinations of four drugs taken over 6 months, Salomon says.

Worldwide each year, 2 million people die from TB and 9 million people develop the active disease.

The fight against TB had progressed steadily during the 20th century until the AIDS pandemic rendered millions of people newly susceptible to it. That has made TB harder to control, particularly in sub-Saharan Africa, says Ann Ginsburg, a pathologist and molecular biologist at the Global Alliance for TB Drug Development, a New York City–based nonprofit group that manages public-private research projects.

Both new drugs use "novel mechanisms of action," says Ginsburg. "Both theoretically should be effective and potent against multidrug-resistant TB strains." —N. SEPPA

derived neurotrophic factor (BDNF), which stabilizes the memory-making operation.

Studies of cells in the laboratory have shown that drugs called ampakines elevate production of BDNF. One ampakine is currently being tested in people with Alzheimer's disease.

In the new study, researchers gave another ampakine, called CX929, to 8-to-10-month-old rats whose memory mechanisms had totally deteriorated with age, reports Julie Lauterborn of the University of California, Irvine.

Some of the rats received two daily doses of the ampakine for 4 days, while others received no treatments. About 18 hours after the rats' final treatments, an analysis of tissue from the hippocampus, the brain's memory hub, showed that the treated rats had twice as much BDNF in their brains as the untreated rats did, Lauterborn and her colleagues report in the August *Journal of Neurophysiology*.

The study is the first to show that ampakines can increase BDNF concentrations, the researchers say.

Moreover, tests showed that the treated rats' memory functions had returned to "100 percent of what the normal young animal would be," Lauterborn says.

The drug stays in the rats' systems for only about an hour, so seeing its effect 18 hours later was "really surprising," Lauterborn notes. If CX929 is developed into a drug for people, "you may only need to take one pill a day, and you can have carryover effects for the next day for memory mechanisms," she suggests. Most memory-recovery drugs now in use must be taken several times a day.

The experimental drug shows great promise for treating diseases that impair memory, including Parkinson's and Huntington's, says coauthor Gary Rogers, a researcher at Cortex Pharmaceuticals in Irvine, Calif., which is developing the drug.

"Now, for Alzheimer's, [drugs] barely treat symptoms. CX929 would perhaps actually modify the outcome of the disease," he says.

The company, which contributed the drug for the rat study but did not fund it, is performing a trial of a different, less powerful ampakine in people. Such clinical testing should begin next year on the ampakine used in the new study, Rogers says.

The data from the rat study look as good as one could hope for, says neural scientist David M. Katz of Case Western Reserve University in Cleveland.

"The fact that they can reverse this age-related decline in hippocampal function, that in and of itself is important," Katz says. "That they can do it using a drug that has promise for clinical efficacy in humans is very exciting." —E. JAFFE

Fish as Farmers

Reef residents tend an algal crop

A damselfish cultivates underwater gardens of an algal species that researchers haven't found growing on its own.

The special alga could be the fishy version of people's domesticated crops, says Hiroki Hata of Kyoto University in Japan. Growth tests of the alga, surveys of its distribution, and genetic analyses support that idea, he and Makoto Kato say in an upcoming *Biology Letters*.

People have been slow to get the hang of farming. Starting millions of years before the rise of human agriculture, certain ants, termites, and ambrosia beetles grew fungi for food. Today, they sow, fertilize, and weed their crops. A few of these spineless cultivators even employ bacteria to make pesticides.

In simpler systems, sometimes referred to as protofarming, mollusks called limpets and certain damselfish graze in territories of edible algae. Hata and Kato have been analyzing the *Stegastes nigricans* damselfish's patches of a *Polysiphonia*, which is categorized as a red alga. The fish defends what looks like a piece of "brown carpet on the reefs," says Hata. The fish nips out bits of other algae and swims outside its territory to spit them out.

Hata and Kato began to suspect that the brown carpet might not persist untended. For example, when they kidnapped the resident damselfish, other fish and sea urchins ate up the alga within days. When the researchers caged farms to keep out both the farmer and interlopers, algae of other species quickly overwhelmed the brown carpet.

To test the farmer-alga bond, Hata and Kato recently collected various algae both inside and outside damselfish territories in the Ryukyu Islands of Japan. The scientists next distinguished four *Polysiphonia* species by analyzing a segment of each one's DNA. One of the species, the brown carpet, turned up only in *S. nigricans* territories, Hata and Kato report. The other algal species were lacking in those territories but appeared both in territories of other damselfish and outside those boundaries.

A specialist in classifying red algae, Gary Saunders of the University of New Brunswick in Fredericton, comments that many animals consume these species, "but for the alga to be dependent on the animal—I just can't think of another case."

He finds it plausible that the alga depends on fish farmers on the reefs that Hata and Kato examined, but he cautions that in other regions, the brown-carpet species might survive independently. "It's a big ocean," he says.

Ulrich Mueller of the University of Texas at Austin, who compares farming species, notes that the algal crop restricts damselfish farms to sunny spots, a limitation that it shares with the crops raised by people. In contrast, fungus raised by insects can grow in dark, protected chambers that reduce exposure to pests.

"It is likely that many more protofarming systems will be discovered in other animal lineages," Mueller predicts. —S. MILIUS

BROWN ACRES **A jet-black damselfish, *Stegastes nigricans*, tends and defends its food crop, a tawny algal fuzz that researchers conclude needs cultivation to survive.**

HATA

SO MANY GREAT TOPICS, ONE GREAT SCIENCE WEEKLY

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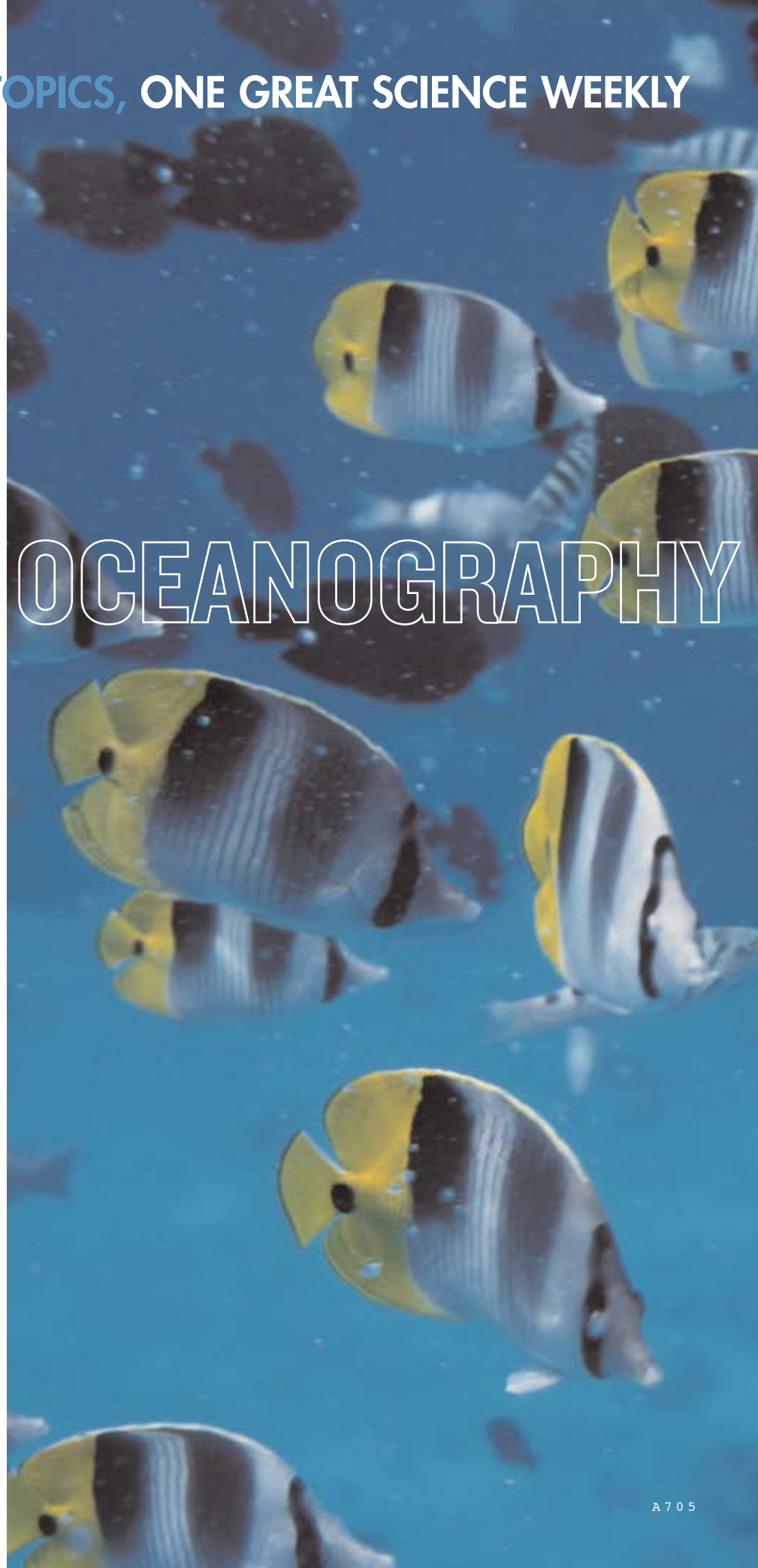


A705

CROUCHING SCIENTIST, HIDDEN DRAGONFLY

Monitoring insect lifestyles in the air and the mud

BY SUSAN MILIUS

When Martin Wikelski and David Wilcove went bird-watching in Cape May, N.J., one fall day in 2004, they were surprised to find that the main spectacle had four wings instead of two. Migrating dragonflies filled the air, flashing iridescent green and blue as they hovered over dunes, perched, then zipped off.

"They were everywhere," says Wikelski, who's a biologist at Princeton University. He and his Princeton colleague Wilcove had come to admire birds that take a break on the long haul up and down the East Coast, but insects on long journeys need rest stops too.

Wikelski has studied bird migration and pioneered the tracking of individuals on long flights. He says that as he and Wilcove marveled at the dragonfly air show along the New Jersey coast, they thought, why not track them too?

The scientists knew the difficulties that they were likely to face. Even the newest, lightest tracking devices might weigh down the insects so much that they couldn't get off the ground. Or the dragonflies might simply refuse to keep migrating after a scientist had glued baggage onto them.

"We knew people would think this was a crazy idea," Wikelski says.

He and his colleagues have now published an account of their efforts. It's one of several recent works exploring hard-to-see aspects of dragonfly life.

Although dragonflies are among the most familiar of insects, science is just beginning to unravel their complex life stories, which start in water and end in air. That cycle sends dragonflies into clashes and coalitions with an unusually wide range of other creatures.

Beyond the satisfaction in discovering details of the lives of charismatic animals, the new approaches to dragonfly ecology have implications for conserving these creatures and the wetlands they rule.

WINGED MIGRATION — Biologist Mike May of Rutgers University checks a common green darner that's in the middle of a long journey.

WHAT'S UP? Migration biologists have spent decades tracking animals en masse. Wikelski contends that what's needed now is an individual bird's-eye view, or bug's-eye view, of how migration works.

The migrant dragonflies that Wikelski set about tracking were the common green darners (*Anax junius*), robust fliers with blue abdomens that turn purple as the temperature rises.

Of the 5,200 species of dragonflies and related damselflies in the world, scientists estimate that 25 to 50 make seasonal migrations. There's evidence for migrations among nine North American species.

These aren't migrations in the bird sense of the word. Each insect makes a one-way trip and another generation returns, scientists presume.

To follow single dragonflies, Wikelski decided on radio tracking.

He sought help from Jim Cochran of Sparrow Systems in Fisher, Ill., who built ultralight transmitters. "Each one of them is like a Stradivarius," says Wikelski.

To test a transmitter, which costs about $200, Wikelski and his colleagues fastened it on a female dragonfly's underside with a nontoxic glue—eyelash adhesive.

Wikelski recalls some nervous moments watching the dragonfly right herself on her perch. The transmitter may be light, but it's still about one-third the weight of a dragonfly itself.

Finally, the transmitter-bearing dragonfly took to the air—and stayed aloft. The team was exuberant. "It was like the launching of the space shuttle; everyone was jumping up and down," Wikelski says.

In all, the researchers attached transmitters to 14 dragonflies.

The researchers followed the insects from the ground as best they could with chase vehicles. At least twice a day, Wikelski got a better view by taking off in a small airplane to locate the insects.

The group followed the individual dragonflies for an average of 6 days, in which the insects covered about 60 kilometers.

On any given day, the insects either made one long flight of up to 6 hours or stayed in one area. "They behave like birds," says Wikelski.

They also stayed put on days when wind speeds topped 25 km per hour, even if the gusts would have swept them along their way.

In an upcoming *Biology Letters*, Wikelski's group describes radio tracking individual dragonflies. Now, the team is calling for a bigger effort, including a satellite dedicated to tracking small animals.

ELUSIVE LADIES Sophie Foster, now at the University of Toronto at Mississauga, has studied the Hine's emerald dragonfly (*Somatochlora hineana*) in Wisconsin. Although it doesn't migrate, there were plenty of questions about its movements. Such as where the females hang out when they're not mating.

In 1995, the federal government listed the Hine's emerald dragonfly as endangered. It survives in patches in the Midwest. Foster studied in Wisconsin's Door County in 2000. She worked with Daniel Soluk, who is now at the University of South Dakota in Vermillion.

The emerald dragonfly males patrol breeding grounds near

ZIEGLER

spring-fed streams. For years, biologists have speculated on why there are so few females in many male territories.

Scientists have proposed various answers, such as die-offs of females or refuges for them in other locations. But Foster found no published tests of any of these ideas.

She and Soluk first wondered whether the missing emerald dragonfly females had ever existed. Dragonflies of that species, like others, start life as eggs in water. They hatch into small aquatic creatures that prey voraciously on other little aquatic creatures. Dragonflies in the final larval form pull themselves out of the water unto a perch, such as an overhanging twig and shed their skin.

To get a tally of the sexes of the maturing insects, Foster scoured the edges of wet patches in the Wisconsin woods, looking for the cast-off skins, or exuvia. "The larvae are impossible to find," she says.

A barely distinguishable dot on an exuvium's underside indicates that it came from a male. Foster found approximately the same numbers of exuvia from males and females, indicating that the sexes reached adulthood in equal numbers.

To determine the whereabouts of adults, Foster organized simultaneous dragonfly chases in the wet breeding grounds and in nearby dry areas, such as meadows, that might work as female sanctuaries.

The surveyors found less than half as many females in the wet areas as in the neighboring dry ones and twice as many males in the breeding areas as in the meadows.

The researchers also hung out strips of flypaper to see whether the females were staying in areas providing more food. However, the wet areas actually offered better dining. Foster and Soluk reported their findings in the January *Biological Conservation*.

Foster speculates that sexual harassment might have driven females to avoid the male-dominated turf. Dragonflies have attracted the interest of biologists studying conflicts within and between the sexes.

Males of several dragonfly species are known to sabotage each other's mating attempts by scraping previously deposited sperm out of a female's reproductive tract before delivering their own. Many males guard their mates, even dragging a female around by her neck after mating.

In Hine's emeralds, Foster has seen importunate males trying so relentlessly to mate that they force a female to the ground. Even females that cooperate can spend more than an hour in an encounter. "That seems like a really long time to monopolize a female," says Foster.

On the basis of these observations, Foster speculates that males may interfere so much with a female's search for food and other activities that females stay away from the guy zone unless specifically seeking a mate and laying eggs. "I couldn't help but draw parallels with going to a bar," Foster says.

The finding "illustrates that wetland species aren't just wetland species," she says. It highlights the importance of conserving areas that are dry as well as those typically considered dragonfly habitat.

SWIM WITH THE DEVIL While Foster looked for missing females, Lauren Pintor and Soluk were investigating a question that might have seemed—at first—like a no-brainer: Were crayfish that eat young Hine's emerald larvae bad for the long-term survival of the endangered species?

Red devil crayfish share the wetlands where Hine's emerald dragonflies live. The crayfish, with streaks of brilliant red on their claws, excavate stream-bank burrows, where they hollow out chambers that hold little pools even in dry weather. The last part of their scientific name, *Cambarus diogenes*, honors the Greek philosopher Diogenes, who took to living in a tub.

Pintor says that she started wondering about those crayfish after a drought left the dragonfly habitat dry for several weeks. "When the habitat was flowing with water once again, many of the Hine's emerald larvae were alive and well," she says. She began trying to figure out how they had survived.

The last wet places around had been the crayfish burrows. Those would have been puzzling refuges for dragonfly larvae, however, since they'd seem to be likely death zones.

SOLUK

EATER AND EMERALD — The devil crayfish (left) sometimes dines on the six-legged larva (right). The insect takes 4 to 5 years to mature from an egg into an adult green-eyed Hine's emerald dragonfly.

A different picture emerged when Pintor tracked the larvae both in crayfish burrows and in the streams themselves. When water was abundant and ran in the streambeds, more larvae showed up there than in the burrows, she found. But, as the water channels dried up, larvae populations grew in the burrows.

The crayfish structures provide a life-saving refuge for dragonfly larvae during summer droughts, even though some probably get eaten there, Pintor, now of the University of California, Davis and Soluk report in the July *Biological Conservation*. Without this information, Pintor notes, well-meaning conservation managers might have culled the crayfish in the dragonfly's habitat, inadvertently dooming many larvae.

WETLAND WIDE WEB Dragonflies are predators as well as prey. A study of ponds in northern Florida reveals an intricate cascade of effects. Tiffany Knight, now of Washington University in St. Louis, and her colleagues compared fishfree ponds with fish-filled ones.

Fewer than half as many dragonflies flitted around the fish-filled ones as around the fish-free ones, say the researchers. Fish readily eat dragonfly larvae, Knight explains. Female dragonflies may shy away from fish-filled waters when choosing sites to lay eggs.

The size of pond-side dragonfly populations affects other creatures, Knight proposes. Dragonflies in the Southeastern United States, according to an earlier study, hunt bees. If pollen is a limiting factor for flower propagation, a bee shortage reduces plants' success.

The researchers monitored pollinators visiting shrubby St. John's worts and broadleaf arrowhead plants near the edges of ponds. More pollinators, and in particular more bees, buzzed around the plants beside the fish ponds than around the plants at fishfree ponds.

To see whether the difference could affect the plant, Knight added pollen to some of the flowers. Both species set more seed when Knight visited them, a sign that pollen was a limiting factor. The limitation showed up especially strongly in the plants beside ponds with no fish.

Acting through the dragonflies, fish are driving the reproductive success of nearby land plants, Knight and her colleagues concluded in the Oct. 6, 2005 *Nature*. The wet-dry dragonfly lifestyle links the aquatic food web to the terrestrial one.

Wetlands themselves are disappearing fast, and the international body that tracks the fate of species, the International Union for the Conservation of Nature and Natural Resources, or IUCN, has raised concerns about more than 100 species of dragonflies and damselflies.

It's clear, though, that Internet-connected, international fan clubs focused on dragonflies aren't in peril. There are also booming populations of dragonfly earrings, fabric patterns, and even Christmas lights. If some of the flesh-and-blood dragonflies become rare, they're among the few insects that people might miss. ■

OUTSIDE LOOKING IN

Researchers open new windows on Asperger syndrome and related disorders

BY BRUCE BOWER

In 2003, neuroscientist Matthew K. Belmonte documented the daily lives of a pair of 13-year-old identical twins with an unusual bond. Both twins have Asperger syndrome, a disorder related to autism and characterized by social cluelessness, repetitive behavior, and unusually narrow interests. Intriguingly, one of these intelligent, genetically alike boys displays a much more severe version of Asperger syndrome than the other does.

The twin with the lesser difficulties—call him Brian—can play with other kids but feels anxious and shy with people he doesn't know. When Brian joins in conversations, he sometimes asks inappropriate questions or suddenly stops talking. He likes to spend time alone at the end of each school day. Brian focuses well on daily tasks, although sequences of instructions can confuse him.

His brother—call him Jason—is even less successful socially. When he tries to play with other kids, he fails miserably. Even with people he knows, he usually feels anxious, rarely smiles, and avoids looking them in the eyes. Like his brother, Jason finds social games confusing and prefers to spend time alone. His stilted conversations typically include inappropriate questions and comments.

Jason, but not Brian, laughs inappropriately. Although he recognizes that problem, he can't change his behavior. During the day, Jason gets confused more often than Brian does.

Both of the boys often trip over their own feet and lack hand-eye coordination.

Birth complications may explain the differences between the brothers, Belmonte says. Brian had no problems at birth, but Jason didn't breathe until physicians administered oxygen.

That brief loss of oxygen altered Jason's brain development in ways that worsened Asperger syndrome, Belmonte proposes. Brain scanning he conducted with Ruth A. Carper of the University of California, San Diego shows that compared with Brian, Jason has a smaller brain overall, a smaller right cerebellum, and a disproportionately large left frontal brain. During a mentally challenging task, Brian's pattern of brain activity is intermediate between that of normal kids and that previously observed in children with autism. Jason's brain activity is so disorganized that it doesn't resemble either pattern.

FRUSTRATION FACE-OFF — An 11-year-old with Asperger syndrome plays a game on his home computer. School officials charged that he had caused trouble in his class by hitting, kicking, and biting.

DALE SPARKS/AP PHOTO

Belmonte's investigation of Jason and Brian belongs to a new wave of research on Asperger syndrome and related disorders. Autism, the most prominent condition in this category, impairs the ability both to communicate and to interact with others, whereas in Asperger syndrome, the problems are primarily social. Autism may include a low IQ or, in high-functioning people with the disorder, an average IQ.

An estimated 1 in 166 children now receives a diagnosis of autism or a variant of it. Those with Asperger syndrome are in the minority, but their prevalence hasn't been accurately measured. The incidence of disorders in the autism spectrum has increased in the past decade. Explanations of that increase remain controversial.

Asperger syndrome is beginning to receive nearly as much scientific attention as autism does. Published in the June *Brain and Cognition*, Belmonte's observations and other new investigations are beginning to document the unusual sensory world of people with Asperger syndrome and the ways in which this condition undermines a person's ability to plan, carry out daily tasks, recognize faces and the emotions behind them, and interact with others. Brain-scan data suggest that kids with Asperger syndrome inherit a genetic propensity to develop this condition from their symptom free parents.

Other evidence suggests that people with Asperger syndrome focus on details and miss the larger picture, especially in social situations.

These findings shed some light on the complex worlds of Asperger syndrome and autism, says Belmonte, who's now at Cornell University. He notes that there aren't clear boundaries between the various sets of symptoms. "It sometimes seems that there as many kinds of autism-spectrum conditions as there are people diagnosed with them," he remarks.

TOO MUCH TOUCH People with autism-spectrum disorders often can't tolerate cold, heat, pain, tickling, itching, certain textures on clothing, and even the touch of other people. As Gunilla Gerland wrote in a 1997 memoir of living with Asperger syndrome, "To be just lightly touched appeared to make my nervous system whimper, as if the nerve ends were curling up."

Sensitivity to touch and difficulties in planning and social interactions reflect underlying problems in dealing with rapidly changing circumstances, researchers now propose. The touch responses reflect a heightened sensitivity to high-frequency vibration of the skin, suggest Sarah-Jayne Blakemore of University College London and her coworkers.

Blakemore's group used a vibrating device to stimulate the tip of the left index finger on 10 adults with Asperger syndrome and 9 adults who had no developmental disorder. Individuals with Asperger syndrome showed much more sensitivity and discomfort to high-frequency vibrations—but there was no difference between the groups when low-frequency vibrations were applied.

In a second experiment, 16 adults with Asperger syndrome rated self- and experimenter-produced tickles on the left palm as much more ticklish and unpleasant than 16 healthy adults did. The researchers speculate that people with Asperger syndrome and autism have a hard time comprehending sensations that become meaningful only after complex neural operations.

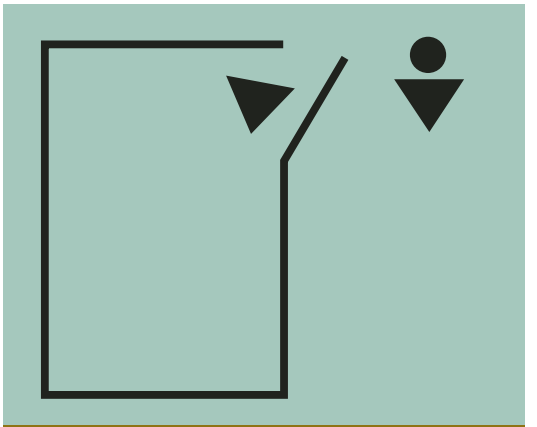
Difficulties at integrating information also play into the poor planning and mental inflexibility observed in autism-spectrum disorders, say Rachael Mackinlay of University College London and her colleagues in the June *Brain and Cognition*. In that group's study, 14 boys, all around age 11, who had Asperger syndrome or high-functioning autism floundered on a game in which they had to follow a set of rules to complete three sorting-and-coloring tasks in 3 minutes.

Compared with 16 boys of the same age who had no developmental problem, those with Asperger syndrome planned sorting-and-coloring strategies less effectively, ignored the game's rules more often, and found it more difficult to switch from one task to another.

Such planning problems often ease during adolescence for kids with Asperger syndrome, according to a team led by Francesca Happé of King's College London. Her group studied 32 boys with Asperger syndrome or high-functioning autism, and 32 boys with no developmental or attention problems. All participants ranged in age from 8 to 16 years.

Boys with no disorders consistently showed the best planning and task-switching skills. However, among boys with the autism-spectrum disorders, teens did better on several of the tests than younger children did.

Still, many adults with Asperger syndrome and related disorders struggle with personal organization. Mackinlay's group cites a mother of one such boy: "I bet he'll become a rocket scientist, but I'll probably have to dress him and drive him to work."



IMPERSONAL ENCOUNTERS — Kids with autism-spectrum disorders don't realize that these shapes, in an animated movie, depict social encounters such as one shape chasing another.

STEREOTYPE SAVERS People with autism-spectrum disorders concentrate on details and parts of what they perceive, thus often missing the big picture, psychologist Uta Frith of University College London proposed more than a decade ago. This fragmented focus—dubbed the weak-central-coherence theory—undermines face recognition and other facets of visual perception and social life.

Yet individuals with Asperger syndrome can still look at a face and assess characteristics such as trustworthiness, Frith and her colleagues find. Social pigeonholing of this kind provides a framework for daily encounters, even if you can't tell your brother from a stranger on the street.

Frith's team devised a task to examine how well a person makes general inferences about others. In various trials, participants were told to assess the age, physical attractiveness, socioeconomic status, or trustworthiness of men in photographs. A group of 16 adults with Asperger syndrome responded much as 24 healthy adults did when judging these attributes.

But participants with Asperger syndrome scored poorly when asked to discern what people must be thinking in scenarios devised by the researchers. Many scientists refer to this social aptitude as "theory of mind" and estimate that it emerges by about age 3 in most children. Firth hypothesizes that people with Asperger syndrome lack theory of mind as a result of a disturbance of their brain networks.

Frith's finding resonates with the idea, developed by Lawrence Hirschfeld of the New School for Social Research in New York City, that judgments about social groups to which people belong operate independently of reasoning about what goes on in other individuals' minds.

Volunteers with Asperger syndrome did encounter one problem in discerning the social attributes of people in pictures. They differed from others in their judgments of sexual attractiveness in a person of their own sex. That process requires taking the perspective of someone of the opposite sex, Frith proposes.

Consistent with Frith's weak-central-coherence theory, visual perception also takes a hit in Asperger syndrome. Neuropsychologist Marlene Behrmann of Carnegie Mellon University in Pittsburgh reports that individuals with autism-spectrum disorders generally do poorly at looking at items and then grouping them into meaningful wholes. For instance, in an image of a large letter *S* formed by lots of copies of the small letter *h*, they often identify only the *h*.

Similarly, according to experiments reported by Behrmann and her colleagues in the June *Trends in Cognitive Sciences*, impaired face recognition in autism-spectrum disorders arises from a tendency to break visual information into parts rather than to see whole entities.

Although Asperger syndrome tends to run in families, no specific genes have been linked to the condition. In 2004, Finnish researchers associated Asperger syndrome with nine stretches of DNA on six different chromosomes.

Psychologist Simon Baron-Cohen of the University of Cambridge in England argues that the genes involved in autism-spectrum disorders foster a souped-up version of brain processes, typically observed in men, that result in perceptual and social impairments. He has detected such brain processes in people with autism-spectrum disorders.

Preliminary support for his view comes from a study, directed by Baron-Cohen, of brain activity in symptomfree parents of children with Asperger syndrome and in adults who had no family members with developmental disorders. Each group contained six men and six women.

The researchers used functional magnetic resonance imaging to measure the rate of blood flow, a reflection of cell activity, in each volunteer's brain during two tests. The first test entailed finding a shape, such as a box, embedded in a larger geometric design. The second test required looking at pictures of a woman's eyes and determining which of two words, such as *concerned* or *unconcerned*, best described her thoughts or feelings.

Parents of kids with Asperger syndrome scored lower than the other group did, especially on the embedded-shapes test. Men and women in the control group showed sex-specific patterns of brain activity, but all the Asperger parents displayed intensified versions of the male sex-specific response.

THE GREAT MYSTERY Wendy Lawson, a British woman diagnosed with Asperger syndrome, has written of her daily social interactions as "a great mystery." She describes having carefully

E. ROELL

studied other people's vocal tones and body language to figure out what they were feeling. Still, Lawson had no idea how to forge friendships.

She wrote in her book *Life Behind Glass: A Personal Account of Autism Spectrum Disorder* (2001, Jessica Kingsley,) "I wanted things to go by the rules—and my rules at that! My clumsy efforts usually ended in trauma."

In 2004, psychologist Emma Williams of the University of Surrey in Guildford, England, analyzed Lawson's and nine others' accounts of living with Asperger syndrome or high-functioning autism. Williams concluded that rather than lacking a theory of mind, as proposed by Frith, people with these conditions theorize ponderously about what others think and feel.

Each writer in Williams' study describes explicit efforts to analyze social situations and generate rules or a library of visual images that can be consulted to understand and predict people's behavior in new encounters, Williams says.

Children don't typically develop a theory of mind as scientists might, she argues. Instead, social learning occurs "on the fly" during interactions with caregivers from infancy onward, she says. Children's emotional reactions serve as intuitive guides to others' intentions and feelings, and typical kids eventually become empathic experts who deal flexibly with people in all sorts of contexts and situations.

In contrast, children with autism-spectrum disorders lack the tools to become empathic experts, so they try to follow rigid rules of conduct. "When rules are the only thing we can go by, our activity becomes inflexible and distressingly prone to failure," Williams remarks.

Psychologist Ami Klin of Yale University School of Medicine agrees. He has found that people with autism disregard basic social cues, such as the movements of other people's eyes. The children end up theorizing awkwardly about what other people are up to, Klin hypothesizes.

However, these kids can solve problems that have specific solutions, so they often pass theory-of-mind tests, such as recognizing where a child will look for a hidden toy, Klin says.

In a new study, Klin and his Yale colleague Warren Jones found that 40 youngsters with various autism-spectrum disorders had great difficulty recognizing that an animated movie of moving geometric shapes represented various social encounters, such as one shape chasing another or starting a fight.

> "This science is fractionated, and we often don't understand how the pieces fit together."
>
> — MATTHEW K. BELMONTE, CORNELL UNIVERSITY

In contrast, the kids, all around age 13, easily recognized that another animated scene with geometric shapes portrayed the launching of a rocket into space and the rocket's orbit around a planet.

"Autism-spectrum disorders primarily involve a social deficit," Klin says. "It makes for a very difficult life."

LOTS OF PIECES Despite much new research on autism-spectrum disorders (*SN: 8/5/06, p. 86*), scientists know little about the neural roots of the problems, Belmonte says. As illustrated by Jason and Brian, the same genes can lead to brain connections shattered in different ways.

Weak-central-coherence theory and other theories of how people with the disorders think need to be unified with theories of how their brains develop, Belmonte holds.

"The irony is that we who study autism-spectrum conditions suffer from a sort of weak central coherence ourselves," he says. "This science is fractionated, and we often don't understand how the pieces fit together." ■

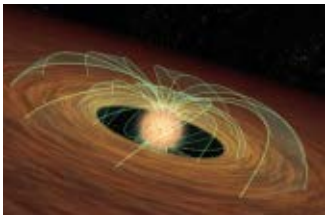
OF NOTE

ASTRONOMY

Braking news: Disks slow down stars

Left to their own devices, young stars would twirl so fast that they'd fly apart. Astronomers have long suspected that the planet-forming disks of gas and dust that surround many newborn stars put the brakes on these whirling dervishes. Now, researchers have the first clear-cut evidence that the young stars' rotations are indeed slowed by their disks.

To investigate, Luisa Rebull of the California Institute of Technology in Pasadena and her colleagues used the infrared Spitzer Space Telescope to study about 500 young stars in a densely packed stellar nursery, the Orion nebula. The telescope can easily find disks because the dust within them absorbs visible light from their parent stars and reemits the radiation at infrared wavelengths.



SLOWDOWN A dusty disk surrounds a young star with a large magnetic field (green, spidery lines) in this artist's depiction. Interactions between the field and particles in the disk seem to slow the rotations of such stars.

CALTECH, JPL/NASA

Rebull and her collaborators divided the Orion stars into those that take more than 1.8 days to complete one rotation and those that take longer. The slow spinners are five times as likely as their faster siblings to have disks, strongly suggesting that disks control the spin, the researchers report in the July 20 *Astrophysical Journal*.

Astronomers have proposed that the slowdown occurs because the strong magnetic fields that emanate from a young star extend into its surrounding disk. Charged particles within the disk drag on the magnetic field, slowing the star. —R.C.

PSYCHOLOGY

Poor sleep can accompany schizophrenia

The body's internal biological clock coordinates a host of rhythms—from hormone production to sleep-wake times—on about a 24-hour cycle. Although everyone's clock tends to run a little fast or slow, sunlight usually resets it. In people with schizophrenia, however, this clock can be seriously broken, a preliminary study finds.

Russell Foster of the University of Oxford in England and his colleagues strapped wristwatch-style activity monitors onto 14 volunteers with schizophrenia. They didn't hold jobs or otherwise have to wake up at a specific time each day. The team also monitored an equal number of healthy unemployed people. The neuroscientists recorded each subject's activity and rest cycles for up to 3 years.

Healthy people maintained standard, relatively unvarying daily patterns. The surprise was how erratic sleep patterns were in all the recruits with schizophrenia, Foster says. The scientists also documented alterations in the timing of hormone production in the participants with schizophrenia, which confirmed that their body clocks were disturbed.

Internal clocks in a few of those people had "lost rhythmicity altogether," Foster notes, and drifted regardless of the day-night cycle. Other participants had fairly consistent sleep-wake cycles, but they tended to be "horribly delayed"—almost as if they were seriously jet lagged, he reported last month at the Euroscience Open Forum in Munich.

These people aren't necessarily sleep deprived. "It's the timing of their sleep that's so very different," Foster says. Indeed, he told *Science News*, "trying to engage socially at a time their body clock is telling them to sleep may exacerbate their [psychosis]." That's why, he argues, efforts to repair clock rhythm through light or sleep therapy might reduce the severity of some schizophrenia symptoms. —J.R.

FOOD & NUTRITION

Blood sugar and spice

Eating cayenne pepper with meals may mitigate a hormonal response that's linked to diabetes, a trial of two diets suggests.

To compare the effects on insulin of different patterns of chili pepper consumption, researchers at the University of Tasmania in Launceston, Australia, conducted a study in 36 healthy adults who didn't typically eat chili peppers. Excess insulin production can presage diabetes.

For 4 weeks of the study, each volunteer ate his or her usual bland diet, except for one chili-laden meal at the end of the period. For another 4 weeks, each person ate 30 grams per day of a condiment that was 55 percent cayenne pepper.

At three points—once during the bland diet, once during the spicy diet, and once at the transition—researchers took blood samples from the volunteers. The scientists measured concentrations of insulin and other substances in the samples.

In metabolizing their meals, the study participants produced about one-third less insulin while they were on a spicy diet than on a bland diet. A stand-alone spicy meal had an intermediate effect on insulin, Madeleine Ball and her colleagues report in the July *American Journal of Clinical Nutrition*. Obese volunteers benefited the most, the study revealed. —B.H.

BIOMEDICINE

Scientists find midnight-snack center in brain

Researchers have tracked down the location of a body clock that appears to be regulated by food.

Several studies have documented that many obese people eat more than half their daily calories at night. Some scientists have hypothesized that these people have an abnormal internal clock somewhere in their brains that tells them to eat at the wrong time.

Launching a search for that clock, Masashi Yanagisawa of the University of Texas Southwestern Medical Center in Dallas and his colleagues flip-flopped the feeding schedules of lab mice, which normally eat at night. The researchers fed the animals at a set time during the day for about a week and then didn't feed them for 2 days.

During the fasting period, the day-fed mice searched for food at their new feeding time. When Yanagisawa's team examined gene activity in these animals' brains, they found that genes in a region called the dorsomedial hypothalamic nucleus (DMH) cycled on and off rhythmically during the day.

Another set of mice had had continuous access to food and had eaten primarily at night. After a 2-day fast, their DMH gene activity was constant, the researchers report in the Aug. 8 *Proceedings of the National Academy of Sciences*.

These results suggest that abnormal DMH-gene activity might be responsible

for nighttime eating in people, says Yanagisawa. If so, the finding would suggest new targets for antiobesity drugs. —C.B.

EARTH SCIENCE

As glaciers shrink, the Alps get taller

As massive glaciers melt in the Alps, the reduction in weight on those peaks is causing them—and the entire region—to gain altitude.

Recent surveys of Alpine glaciers suggest that the ice masses as a whole are losing more than 1.5 billion tons each year, says Claudio Smiraglia, a glaciologist at the University of Milan in Italy. As glacial melt flows to the sea, immense pressures from deep within Earth that had been counterbalanced by glacial weight cause the planet's crust to spring upward. While some altitude gain occurs almost immediately, the remainder takes place over centuries.

Computer models suggest that in the immediate effects of recent melting, the entire Alpine region is rising about 0.15 millimeter each year, Smiraglia and his colleagues report in the July 28 *Geophysical Research Letters*. In areas with large, rapidly melting glaciers, such as the Austrian Alps, peaks are rising annually at rates of 0.4 mm or more. Mont Blanc, the tallest peak in the mountain chain, is growing by about 0.9 mm annually, the team estimates.

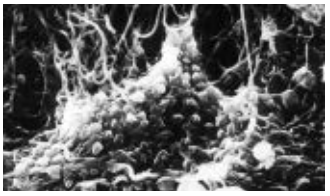
The models also show a long-term effect of the melting of 155 cubic kilometers of Alpine ice since 1850. That effect contributes an additional altitude gain of 0.32 mm per year, the researchers note. —S.P.

BIOLOGY

Blood clot protein is stretchiest natural fiber ever found

Scientists have new clues to how blood clots seal off wounded blood vessels despite the pressure generated by the pumping heart. The protein that's the backbone of these clots can stretch to several times its length and snap back to its original size, a new study shows.

Blood clots result when this protein, called fibrin, forms a sticky web riddled with cell fragments called platelets. To investigate the extraordinary stretchiness of blood clots, a team of researchers led by Susan T. Lord of the University of North Carolina in Chapel Hill and Martin Guthold of Wake Forest University in Winston-Salem, N.C., measured how far individual fibrin fibers can stretch. The researchers draped sticky strands of fibrin, each several micrometers in length, across microscopic channels. The scientists then dragged the needlelike tip of an atomic force microscope through the channels and tugged on each strand, measuring how far it stretched before it broke.



BLOOD BROTHERS Spherical red blood cells and platelets combine with stringy fibrin fibers to form a clot.

On average, a fibrin fiber could reach 2.8 times its length and still spring back to its starting length, the researchers report in the Aug. 4 *Science*. The fibers stretched to 4.3 times their lengths before snapping. No other natural fiber that has been measured exceeds this stretchiness.

Lord notes that the finding gives researchers more-accurate information for modeling blood clots, which could advance treatment of heart attacks and strokes. Fibrin could also serve as a model for creating stronger synthetic materials. —C.B.

EARTH SCIENCE

Obsidian artifacts can record ancient climate

The layer of material that forms on the surfaces of arrow points, spearheads, and certain other natural-glass objects, as they age can be used to estimate the temperatures that the artifacts have experienced, a new analysis suggests.

The researchers focused on ancient objects made of the volcanic glass called obsidian. As soon as such an object breaks, its freshly exposed surfaces begin to absorb water, or hydrate. The rates at which those surface layers thicken depend on the temperature and humidity of the object's surroundings, says Lawrence M. Anovitz, a geochemist at the University of Tennessee in Knoxville. Now, he and his colleagues at the Oak Ridge (Tenn.) National Laboratory have turned that trait into a climate-monitoring tool.

To date the objects in their study, the researchers used obsidian artifacts found alongside objects that could be carbon-dated. They assumed that the obsidian and the other artifacts in a particular sediment layer are the same age. Given that age, they could deduce the environmental conditions from the thickness of the hydrated layer on the obsidian, Anovitz notes.

The researchers studied artifacts recovered at the Chalco site southeast of Mexico City. Analyses of the obsidian objects created between 900 and 450 years ago indicate that soil temperatures there have been about 21.3°C since the objects' manufacture. However, hydrated layers on the artifacts that were produced between 1,450 and 1,350 years ago indicate that soil temperatures then were about 5°C warmer. Other indicators of the region's climate history have suggested similar changes in temperature, the researchers note in the July *Geology*. —S.P.

TECHNOLOGY

Glare gives silicon goose bumps

Fluorescent lighting in chip factories creates tiny, possibly troublesome welts on the silicon used to make microcircuits, new experiments suggest.

Scientists who have seen such nanoscale bumps form in their lab say that light might be causing defects in the commercial chips most densely packed with transistors. Chips with such defects are probably among those discarded during production.

As future chips become denser still, it will become more critical to avoid roughened silicon surfaces, says Hitohi Morinaga of Tohoku University in Sendai, Japan. The bumps can cause current to leak or flow poorly.

Morinaga and his Tohoku colleagues Kenji Shimaoka and Tadhiro Ohmi report on light-induced silicon roughness, including surface pits, in the July *Journal of the Electrochemical Society*.

The team was investigating the use of light to clean chips when "we found, by accident, that light had an adverse effect," Morinaga recalls. The researchers' experiments later revealed what they call hillocks when silicon is both illuminated by fluorescent lights and immersed in ultrapure water or in chemicals like those used commercially to etch and clean chips. The bumps result from light-induced oxidation followed by nonuniform etching of a silicon surface, the team found.

To prevent such roughening, chip factories "will require controlled illumination conditions," predicts Takayuki Homma of Waseda University in Tokyo. Some other semiconductor specialists doubt that such a move is necessary.

Materials scientist Steven Verhaverbeke of Applied Materials in Sunnyvale, Calif., says that the findings might lead to some changes in production processes. —P.W.

R. REDDICK

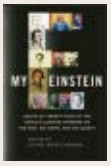
Books

A selection of new and notable books of scientific interest

MY EINSTEIN: Essays by Twenty-Four of the World's Leading Thinkers on the Man, His Work, and His Legacy

JOHN BROCKMAN, ED.

Einstein was one of the most influential physicists ever and one of the most famous figures of the 20th century. This book is a collection of musings and memories by 24 theoretical and experimental physicists, cosmologists, science historians, and science journalists about this legendary man and his ideas. Contributors include science editor Roger Highfield, who provides insights into Einstein's personal life, physicist John Archibald Wheeler, who describes his personal contacts with Einstein, writer Charles Seife, who details Einstein's attempts to disprove quantum theory, and physicist Richard Muller, who discusses Einstein's contributions to our understanding of time. ***Pantheon, 2006, 259 p., hardcover, $25.00.***



THE FEMALE BRAIN

LOUANN BRIZENDINE

While men and women share more than 99 percent of their genetic coding, the remaining 1 percent makes the two sexes' perceptions of the world profoundly different. Scientists are becoming more aware of how hormones and other biological chemicals affect both the structure and function of a woman's brain over her life span. Brizendine, a neuropsychiarist at the University of California, San Francisco, writes that while male brains remain relatively stable day-to-day, female brains are subjected to fluctuating concentrations of estrogen, progesterone, and other hormones that subject women to a range of emotional experiences. The author explains how these changes are adaptive, helping women protect themselves against threatening situations, develop relationships, find mates, and rear children. She describes why women are, on average, better communicators than men, using more than twice the number of words that men do daily; how women remember minute details of emotion-laden events that men forget ever happened; and why women are more than twice as likely to suffer from depression as men are. ***Broadway, 2006, 279 p., hardcover, $24.95.***

HOLLOW EARTH: The Long and Curious History of Imagining Strange Lands, Fantastical Creatures, Advanced Civilizations, and Marvelous Machines Below the Earth's Surface

DAVID STANDISH

In 1692, Edmond Halley submitted a paper to the British Royal Society stating that Earth is hollow. That idea, an attempt to explain Earth's magnetism, wasn't novel. Societies the world over had believed in various subterranean worlds for aeons. Standish, a professor and author, reveals how the notion of a hollow Earth has been explored in both literature and science, from Dante's *Inferno* to Jules Verne's *Journey to the Center of the Earth*. He describes how early expeditions to the South Pole were motivated by the search for openings to Earth's interior called Symmes' holes, and how, in the late 1800s, a man named Cyrus Teed proposed that the inhabitable world was actually on the concave surface of a globe's interior. In the early 20th century, science established the geophysical impossibility of a hollow Earth. Facts, however, haven't dissuaded legions of storytellers from imagining an inner world. ***Perseus, 2006, 304 p., b&w images, hardcover, $24.95.***

BLAME IT ON THE RAIN: How the Weather Has Changed History

LAURA LEE

Short of catastrophic storms, changing weather conditions usually are only a minor inconvenience in this day and age. But historically, as author Lee reveals, the weather has affected the outcome of wars and political elections. It has meant the difference between life and death for explorers and women accused of being witches. Lee describes how natural weather phenomena, such as lightning and hail, were seen in past centuries as signs from God. One such storm in 1360, for instance, led to the signing of the treaty of Bretigny between France and England. Vicious storms in the Atlantic Ocean contributed to England's defeat of the Spanish armada in 1588. The bitter cold of Russia's winters have been linked to Napoleon's defeat in 1812 and Hitler's in 1943. Ordinary rain clouds may have been the cause of the Hindenburg disaster. Lee describes how heat in 1967 set off racially charged riots across the United States and how a warm spell in 1991 led to the discovery in the Alps of the 5,000-year-old body of a hiker. ***Harper, 2006, 314 p., paperback, $13.95.***

TO CHERISH THE LIFE OF THE WORLD: Selected Letters of Margaret Mead

MARGARET M. CAFFREY AND PATRICIA A. FRANCIS, EDS.

Margaret Mead was an influential American cultural anthropologist and feminist who offered the world an unprecedented look into the cultural practices of the people of Samoa through her landmark book *Coming of Age in Samoa* (1928, Harper Perennial). At the time, her fieldwork was controversial because it challenged some of the prevailing ideas about interpersonal relationships. Her personal life was defined by introspection and the rich relationships, which she maintained through prolific letter writing, despite her fieldwork in remote locations. Caffrey, an author and professor of history, and Francis, curator of a past Mead exhibition at the Library of Congress, have drawn on the letters in Mead's papers collected there. The documents reveal Mead's philosophy, including her strong sense of family responsibility, her relationships with three husbands and both male and female lovers, and new details on her 55-year career. ***Perseus, 2006, 429 p., hardcover, b&w plates, $29.95.***

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LETTERS

Dates of contention

Are the dates quoted in "Stones of Contention: Tiny *Homo* species tied to ancient tool tradition" (*SN: 6/3/06, p. 341*) correct? I didn't think *Homo* existed as a genus 840,000 years ago.

DAVID ADAMS, BOOTHWYN, PA.

Fossil finds indicate that the Homo *genus originated roughly 2.4 million years ago.* —B. BOWER

No juicy story

"Homegrown Defender: Urinary infections face natural guard" (*SN: 6/10/06, p. 355*) leads me to ask if this explains the efficacy of that standard home remedy for preventing urinary tract infections: cranberry juice. Does it contain a cathelicidin mimic or some irritant that (benignly) stimulates cathelicidin secretions?

GREGORY HONCHUL, WEST LIBERTY, KY.

There is evidence that the juice can thwart bladder infections, but the mechanism appears to be in preventing bacteria from binding to cells lining the urinary tract. The microbes then get flushed out. In contrast, the body's homemade cathelicidins puncture a bacterium's membrane and kill it, a more direct approach. —N. SEPPA

Divide and conquer

Reading the June 10 issue, I was prepared to catch the Simpsonesque spoof (blunder?) in the "Leggiest Animal: Champ millipede located after 79-year gap" (*SN: 6/10/06, p. 357*). Perhaps the creature had up to 748 legs, or possibly up to 752 legs, but not "up to 750 legs."

DAVID CLARK, LITITZ, PA.

Researcher Paul Marek of East Carolina University explains that Illacme plenipes *has four legs per segment, except for segments 2, 3, and 4, which have one pair each, and three segments that don't have any legs. So, an individual with 192 segments would have 750 legs.* —S. MILIUS

Disorder in the court

With the known link of asbestos to lung cancer, the new finding that many other diseases can be caused by asbestos only serves as fodder for litigation, clogging of our legal system, and, unfortunately, more enrichment of trial lawyers instead of asbestos victims ("Mineral Deposit: Asbestos linked to lupus, arthritis," *SN: 6/17/06, p. 372*).

NELSON MARANS, SILVER SPRING, MD.

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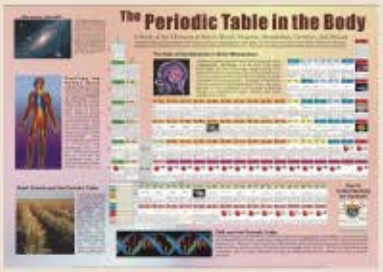

The Periodic Table in the Body poster discusses each of the elements on the Periodic Table in relation to how the body uses them. It helps us understand how the elements are used by bones, blood, metabolism, genetics, and disease. Also, there are five sections to this periodic table poster. One section examines why we are indeed "star stuff" and our chemical ties to the universe; others profile the chemical makeup of the human body, plant growth, DNA, and the role of the elements in brain metabolism. Full color, laminated. 28"W X 38"H poster, Copyright 2007
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Rocks, Minerals and Gemstones of the U.S. - 100 piece set, size: 20"L X 12"W X 1"D, Oak casing. Great for classrooms, collectors or young scientists. Suitable for wall hanging. **Order #JPT-1888, Cost: $85.00** *Information sheet and meteorite included!*

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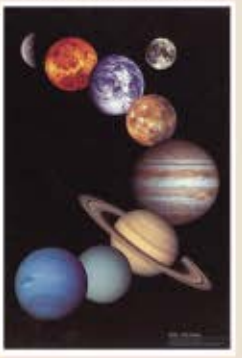

NASA Solar System Poster - Size: 26.75" X 38.5" Laminated! - Simply beautiful with great color. Order **# JPT-System12** Cost: **$15.95**

The Hubble Space Telescope

The Hubble Space Telescope poster - *New!* Eighteen fabulous images from Hubble, with additional information on its design. This poster depicts many Hubble images. Size: 24" W X 36"L., Laminated.
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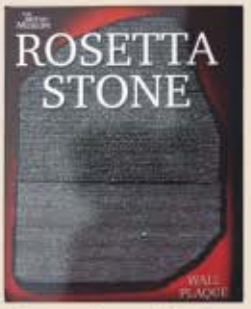
Clear Star-Shaped Leucite Pendant with Gibeon Meteorite- Pendant size: approximately 1" X 1" ; comes with 18" stainless steel chain, info and jewelry box, order **#JPT-0613, Cost: $32.95**

Oviraptor in Egg Replica - Authentic, hand-painted replica of the first carnivorous dinosaur embryo ever found. It was discovered in 1994, in Mongolia. The replica is the actual size and is constructed of durable polyvinyl. NEW! Comes with educational tag. Size: 5"L X 3"H **Order: #JPT-ovegg, Cost $12.95**; *replica with small real, generic dino egg shell, with info.* ***#JPT-ovishell*, Cost $19.95**

RMS Titanic Shipwreck Coal
The Titanic coal is suspended in four different designs of jewelry. These hand-fashioned blown glass pendants have the precious shipwreck coal sealed safely inside. All are between 1.1 inches and 1.38 inches in length. Each comes with a braided cord that will adjust to fit all neck sizes and is suitable all ages. Each is accompanied by a certificate of authenticity. Order **#JPT-titan - list style**... either an *Anchor, Cross, Dolphin* or *Teardrop*. ***Cost: $24.95 each; or #JPT-5555 - 2 for $40***



Rosetta Stone Wall Plaque - Replica
Size: 12 3/8" X 10 5/8"
JPT-Rosetta, Cost: $85

Unique Meteorite Pendant
NWA 869 has lot of chondrules and is very showy! Comes with information & authenticity. Size: 1" X 1" Sterling Silver pendant comes with braided sterling silver chain 20". For the person that wants something "out of this world." **#JPT-metpndt $75.00**

Gudea Statue

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Gudea Statue (above) replica - Reproduction of the Statue of Gudea of Ur, Third Dynasty - Gudea was a great Prince of Lagash. During his reign (about 2050 B.C.E) he was a prolific builder, judge, and patron of the arts and literature. The statue replica comes with an information sheet and details about ancient laws. *Great impressive historical piece!* Statue size: 13" H X 6" W X 6" D, Weight: 5.4 lbs. **Order #JPT-Gudea, Cost $85**

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