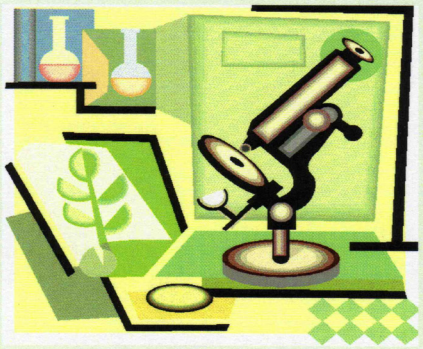

Scope

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Planetary Science

Comet Holmes Bursts onto the Celestial Stage

by Megan Rulison
Scope Correspondent

A little comet named Holmes has unexpectedly brightened a millionfold, and it's causing a flurry of excitement among skywatchers in the Northern Hemisphere. The comet is now so brilliant that it can be seen through city lights or even under a full moon.

On October 23 this year, Holmes was almost invisible and had been so since its discovery a century ago. Then on the following night, J. A. Henriquez Santana, an astronomer in Madrid, observed the comet shining four thousand times brighter than before. Tracked by astronomers across the globe, the comet was seen to brighten steadily throughout the evening. By the end of the night, it was an astounding million times brighter. The glow of Holmes eventually appeared larger than Jupiter's. The Harvard-Smithsonian Center for Astrophysics is calling it a "stunning outburst" that is "brighter than any comet in the past decade."

What caused a dim, obscure comet to blossom into a far brighter orb? Multiple hypotheses abound, but Richard Binzel, professor of planetary science at MIT, said it's most likely the comet "blew its top."

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Mental Health

Rise in Bipolar Disorders Raises Questions

by Grace Chua
Scope Correspondent

Mood swings and grandiose delusions may clearly characterize bipolar disorder in adults, but doctors don't really know what bipolar disorder looks like in their younger patients. In fact, mania in children can often look like aggression, irritability, even cravings for sweets. That confusion may help explain why researchers found child bipolar diagnoses rising dramatically, more than fortyfold, over the last decade.

In a recent Columbia University study, Dr. Mark Olfson and colleagues examined the number of times children and young adults, under nineteen, were diagnosed with bipolar disorder in doctor office visits. They found a sharp rise, from 20,000 diagnoses in 1994 to 800,000 in 2003. And not only did diagnoses go up, but children were more likely than adults to be given mood-altering drugs.

Olfson's team surmised that the illness had been underrecognized, but also that clinicians increasingly aware of bipolar disorder were more sensitive to it in children. But is that the whole story?

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Inside

Comet Holmes

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A comet is a large mass of ice and rock, like a snowball rolled on a gravel driveway. The comet absorbs heat as it passes the sun, Binzel explained, causing ice beneath the gravel surface to vaporize, creating gas bubbles. Eventually, after many passes around the sun, one or more of those bubbles will burst, blowing off a layer of dust and rock. With that outer layer gone, new ice inside the comet is exposed to the sun for the first time in billions of years. Large portions of the new ice vaporize into a great cloud of gas and dust. This cloud reflects the sun, shining so brightly we can see it from our own backyards.

But this isn't the first times Holmes has blown off a layer. According to Brian Marsden, a comet specialist at the Harvard-Smithsonian Center, it was during a similar outburst that Edwin Holmes first discovered the comet in 1892. Even more interesting, Marsden notes, is that then, as now, the comet was not at its closest location to the sun, when a comet is mostly likely to have an outburst. Holmes is now some 37 million miles beyond that point. "I know of no other comet that has come close to such fantastic behavior," Marsden noted in an email.

Are we seeing a rare cosmic event?

"Comets always surprise us," Binzel said with a smile. He recalls David Levy, a famed comet-discover, who said, "Comets are like cats; they have tails, and they do precisely what they want." Part of Holmes's novelty, however, is that there is no tail visible from Earth. Currently, the tail is pointed away from us, leaving Holmes looking like a big fuzzball.

Comet Holmes
Photo credit: Arkansas Sky Observatories/Clay Sherrod

Bipolar

cont. from page 1

Maybe not. Clinical psychologist Janine Scheiner, a child mental-health specialist from Norwich, Vermont, says, "The question is, are we seeing actual cases that we've missed before, or are we overdiagnosing?" Is the increase possibly linked to something disease-causing in the environment?

Dr. Scheiner, who was not involved in the study, also points out that since 2000 the National Institute of Mental Health has recognized the existence of a broader pediatric bipolar phenotype—the children who show up at the doctor's office with bipolar symptoms but don't meet strict diagnostic criteria for the disease. Perhaps such cases accounted for some of the jump in diagnoses.

So before psychiatrists rush to prescribe powerful mood stabilizers for children with pediatric bipolar disorder, they have to figure out both why diagnoses are rising and how to differentiate all those child bipolar cases from one another.

Archaeology

Researchers Uncover Ice-Age Clambake

by Ashley Yeager
Scope Correspondent

In South African caves overlooking the Indian Ocean, anthropologists have found evidence that our ancestors were hosting clambakes and painting themselves with makeup more than 160,000 years ago—the oldest signs of such familiar cultural activities found to date.

An international team of researchers, digging at Pinnacle Point near the southern tip of Africa, has uncovered ancient hearths filled with mollusk shells, pinky-finger-sized stone blades, and powdered pigments likely used for body paint.

Finding these three clues to cultural development together is extraordinarily rare, the scientists wrote in the October 18 issue of *Nature*, but more surprising was evidence that these humans were enjoying seafood and painting themselves so long ago.

"These people were doing what we consider modern activities much earlier than previously thought," said Paul Goldberg, a Boston University archaeologist involved in the excavation. They were harvesting seafood 40,000 years earlier and possibly sharpening blades 70,000 years sooner than scientists believed. The new artifacts challenge the old view that modern culture arose all at once some 50,000 years ago. Instead it looks like individual elements of such culture appeared in fits and starts over a period of several hundred thousand years.

Pinnacle Peak, courtesy of the journal Nature

"As with many such finds, the material is still rather fragmentary, but scientists have to make major inferences from it," British anthropologist Chris Stringer said in an e-mail.

Stringer, who was not involved in the study, explained that genetic and fossil data show that anatomically modern *Homo sapiens*—people whose bones are indistinguishable from those of humans today—arose in Africa about 175,000 years ago. Scientists have been uncertain, however, when our ancestors first exhibited modern behaviors.

"The cave preserved material from a time when we have little evidence of humans in Africa," he said. "Yet this is a time we assume was critical in our evolution." The Pinnacle Point findings indicate that seafood might have been critical to helping these modern people survive.

Evidence from 160,000–year-old ice samples shows the Earth was experiencing an Ice Age at the time, so the scientists working at Pinnacle Point think Africa was probably more arid when these humans inhabited the area's caves. Food from land resources would have been scarce, forcing them to forage along the coast.

The scientists also said that since shellfish collecting is an activity associated with hunter-gatherer communities of greater social complexity, this activity could have influenced early people to experiment with material culture, such as painting their bodies and sharpening tiny bladelets.

"Archeology is often based on a little data and a lot of ideas," Goldberg concedes, but he adds that the Pinnacle Point project is unique, because of the "impeccable data" the scientists collected. They not only analyzed the physical artifacts, but also used Geographical Information Systems, GIS, to digitally reconstruct how the terrain of Pinnacle Point looked some 160,000 years ago. Taking more than 800 photos along the floor and walls of the cave and also the surrounding shore, the scientists animated and then manipulated the data to place the physical artifacts into their historical context.

"We feel like we know what was really happening there," Goldberg said.

Psychology

Did Religion Aid the Rise of Ancient Societies?

by Rachel VanCott
Scope Correspondent

The psychological impact of ancient religion may have encouraged the rise of large cooperative human societies, according to a study published in the September issue of *Psychological Science*.

Cooperative societies depend on everyone doing their part, said Azim Sheriff, lead author of the study and a doctoral student at the University of British Columbia. But, he said, in big societies it's hard to be sure that there aren't cheaters who enjoy the benefits of the group but contribute nothing.

That's where the concept of God comes in.

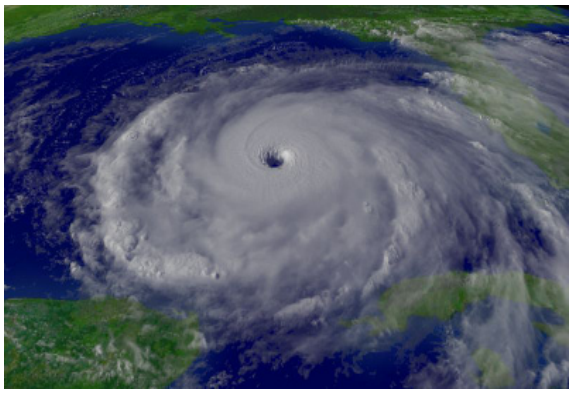
"A lot of religions have this idea of an omniscient moral watcher," Sheriff said. "Now that there's a supernatural watcher, you're going to act more cooperatively. Not because you're afraid of what your fellow man will see. But you're afraid of what this all-seeing-eye will see."

To test whether the suggestion of religious concepts promotes cooperative behavior, Shariff and a colleague first gave subjects a puzzle containing words that were morally neutral (paper, for example, and train), religious (divine, spirit), or secular but moral words (police, contract). Then, subjects were asked to play the "dictator game" to test their willingness to help a stranger in an economic game.

Subjects were presented ten one-dollar coins and told to take as much as they wanted, and that whatever was left would go to the next subject. The most cooperative choice would be to take half the money. And, as predicted, subjects from groups prompted with religious and secular moral prompts did take about half. But subjects with a neutral prompt made a more selfish choice and took nearly three quarters of the money.

The difference, researchers said, may be due to what they call a watcher effect. When subjects are reminded of a moral agent, be it supernatural or secular, they are less selfish.

Researchers are working to learn more about what precisely creates this watcher effect.



Hurricane Rita (Category 5), courtesy of NASA

Weather

Fewer but More Powerful Storms Might Arrive with Global Warming

by Andrew Moseman
Scope Correspondent

Category 5 hurricanes, F5 tornadoes, and ferocious wildfires kill people and demolish buildings. But a storm doesn't need a first name or an appearance on the evening news to wreak havoc on society. Lengthy droughts wreck farmland, and so can downpours that flood the land and wash away precious topsoil.

In short, the far ends of the weather spectrum are not good for human enterprise. So the news out of NASA's Goddard Institute for Space Science in August caused some concern for those seeking a little balance. Tony Del Genio and his colleagues created a mathematical simulation of atmosphere and ocean patterns and jacked up the carbon dioxide in the air to twice its pre-industrial level, which scientists expect to reach this century. In response, average worldwide temperature in the model rose by about five degrees Fahrenheit—no surprise there. It was the storms that rang the alarm.

Higher temperatures fed more energy into the atmospheric convection engine that powers storms, specifically increasing updraft, the upward motion of air that can make storms more severe. Perhaps counter-intuitively, this produced fewer storms. But the ones that came were more likely to be strong and destructive.

On top of that, Del Genio said, dry areas like the Western U.S. are likelier to become drier, and with the increase in lighting strikes that his model predicts, wildfires would become more common and harder to stop.

"Extremes are going to become more extreme on both ends," he said.

Nanotechnology

IBM One Nano-Step Closer to Single-Atom Data Storage

by Lissa Harris
Scope Correspondent

As a corporate logo, Don Eigler's picture wasn't much to look at: a bunch of dour-gray dots spelling out the letters IBM. But it did the job. The year was 1989, the dots were individual xenon atoms, and the world was astounded.

These days, Eigler's lab, at IBM's Almaden Research Center in California, is still looking for new ways to make stuff ever more mind-bogglingly tiny. Their ultimate goal: to store digital data on single atoms, each representing either a zero or a one in binary code. Recently, they got a little closer. Well, maybe a lot closer.

Atoms have two possible orientations, spin up and spin down—a quality that makes them useful for computing. With transistors that small, nanotechnology cheerleaders love to boast, a computer the size of a sugar cube could hold the entire contents of the Library of Congress. But to use spins to store information, you need at the outset to solve three problems. First, you need to be able to measure them. Second, you have to be able to switch them back and forth if you feel like it. And third, you need to be able to keep them from spontaneously changing.

In August, Almaden researchers declared that for the first time, they have measured a special property called magnetic anisotropy in single atoms, which allows them to determine how much energy it takes for the atom to switch orientations. It's no quantum iPod, but it's a big step in the direction of solving Problem No. 3.

"If the question is, 'How long 'til you have single-atom data storage in a product?' the answer is, easily, 'Decades,'" said IBM scientist Cyrus Hirjibehedin. "We're a long, long way from something commercial. But this is how you get there."

> *"There isn't a scientific community. It is a culture. It is a very undisciplined organization."*
> — Physicist I. I. Rabi, 1965.

Astronomy

Space Infrared Telescope Spies Distant Solar System Forming

by Ashley Yeager
Scope Correspondent

Move over Betty Crocker. There's a new baker in town—a baby star.

This infant ball of gas is so hungry to gain weight and outshine mature stars, like our sun, that it greedily ingests its embryonic cloud, where bits of dust and ice swirl about the star and eventually coalesce into a pancake-like disk around it.

That's the story Dan Watson tells his children, anyway, when they ask how planets and stars are made, but the planetary astronomer and his colleagues have long sought evidence to illustrate this anecdote about how a solar system forms.

Now Watson has at last seen a young star's first steps in feeding itself. "It goes something like this but more slowly," he says. "Bits of the embryonic cloud fall onto this pancake disk, and from there, fall onto a baby star."

Pointing the Spitzer Space telescope at a stellar nursery in the constellation Perseus, Watson hoped to watch a bevy of infant stars stir up their pancakes. For the first time, the University of Rochester astronomer captured a rare moment when water, swirling about in the chilly embryonic cloud in the form of ice, collides with an infant star's orbiting pancake. On impact, the ice vaporizes, glowing in infrared light.

The telescope captured this burst of light from a baby star named IRAS4B, and the images revealed the distinct chemical fingerprint of water. This life elixir makes up only a small part of the overall cloud, but it is the easiest to detect, making it a key ingredient to explore how stars make their pancakes. In this way, astronomers can learn how and when a star's leftovers coalesce into planets and maybe tell the story of how those bits of ice eventually become planetary oceans.

> *"After a year's research, one realizes that it could have been done in a week."*
> — Physicist William Bragg, 1962

Genetics

Individual Genome Sequenced; Some Biologists Question the Goals

by Megan Rulison
Scope Correspondent

For the first time, scientists have sequenced a complete individual genome, the full 46 chromosomes that create and maintain a living human being. And they hope to do the same for you someday, but for less than the 70 million dollars it cost this time around.

J. Craig Venter

It was the complete genome of J. Craig Venter, legendary among biologists for chasing genome-sequencing prizes. Unlike previous genomes compiled piecemeal from anonymous volunteers and containing only one chromosome from each of the 23 pairs, Venter's genome sequence has the DNA code for all 46.

Venter's team champions the feat as progress toward genomes for all, a future where personalized medicine based on genetics is available to everyone. But some biologists contest that point, arguing that Venter's research has made little progress in advancing personal genomics for public use.

George Church, co-founder of the Human Genome Project and a leader in genomic sequencing, is one of those skeptics. "There's a problem in that paper with the scale of it," he states. If genomes for all is the goal, argues Church, then Venter's team is doing the wrong kind of research. He points out that they made no attempt to seek affordability, obtain multiple and diverse participants, or address privacy and ethical issues, all pertinent areas of research before personal genomics can become a public reality.

Church's own organization, the Personal Genome Project, is studying technological and social challenges in the field, hoping to recruit thousands of volunteers and sequence their genomes for less than $1,000 each.

Mathematics

Mathematics Could Make Buses Run on Time

by Lissa Harris
Scope Correspondent

As many city commuters know, it is the nature of buses to be late. Traffic, weather, and fate conspire to create delay and fray riders' nerves. But while there may be no sure cure for late buses, three mathematicians think they have found a way the system can do better.

A University of Southern California trio—Maged Dessouky, Jiamin Zhao, and Satish Bukkapatnam—last year developed a set of elegant equations for increasing the efficiency of bus schedules. This November their work won an award from an international organization, the Institute for Operations Research and Management Science, dedicated to using math and computers to make the real world more efficient.

The winning paper tackles the problem of slack. Every bus route needs some slack time built in between trips to account for traffic and other delays. Schedule too much slack, however, and the buses won't come as often as they should. Use too little, and buses will tend to be late, throwing the whole schedule out of whack as delays accumulate.

Currently, Dessouky said, most bus schedulers use rules of thumb to decide how much slack to build into a route. But if they adopt the USC formula, bus schedulers would take data on actual bus departure and arrival times—which most agencies already collect—and feed them into a computer. Once programmed, there is no further cost to use the computer model. "It's not something that needs updating," he said. But no matter how cheap the algorithm would be to put into practice, it may be a long time before it catches on in the bureaucratic world of public transit.

In big business, by contrast, such change has become routine. In the last twenty years, applied math of the kind Dessouky does has transformed the way many companies do business. Take, for example, Six Sigma, which started at Motorola in the 1980s as a management movement to combat the waste of time and money using statistical analysis. FedEx uses such computer modeling to get packages delivered faster. Netflix has built a billion-dollar business around its top-secret algorithm for distributing DVDs.

Yet the mathematical tools that have built thousands of better mousetraps for businesses are somehow slower to catch on in the public sector. The problem of moving people around on buses is not fundamentally different from manufacturing cell phones or delivering movies, Dessouky said. The trouble is that public planning agencies aren't rewarded for efficiency.

"They don't go out to the research community. They don't seek solutions that are novel," he said. "And it goes both ways … It's not something we [academics] go out and do, sell our solutions to agencies and profit from it."

USC's commercialization center, which helps researchers market their ideas, is working to spread the word about the paper among city transit planners. But it may be a tough sell for most transit agencies, where politics reign. Budgets are tight and change comes slowly. Still, Dessouky thinks approaches like his will catch on someday.

"What you hear in the private sector is what you're going to see in the public sector eventually," he said. "I see almost a revolution in ten to twenty years in transit."

"Hofstadter's Law: It always takes longer than you expect, even when you take into account Hofstadter's Law."

— Douglas Hofstadter, 1979.

Essay

Good Time to Be a Deer

by Andrew Moseman
Scope Correspondent

When there are too many deer, it's easy. You shoot them. Supposing too few natural predators can be found (say, bearded men with rifles), you recruit some more. "State's Next Hunters Sought; As Deer Season Nears, Experts Wonder if Future Herds Will Be Kept in Check," a Milwaukee *Journal-Sentinel* headline declared last September.

By some accounts, it's a good time to be a deer—food is abundant, winters mild, and baby-boomers are growing too old to hunt, says the *Journal-Sentinel*. New hunters are either too befuddled by the state's huge volume of regulations or too soft to grab a rifle and thin out the herd. But make no mistake—the American Nordic male hasn't gone metrosexual. Men will still be gone for the weekend. They simply aren't shooting enough deer.

Population excess is bad for both people and deer: too many deer cause too many car accidents, eat too much foliage, and spread disease too easily among their compressed ranks. Even a young teenager unsure about taking an innocent animal's life for sport has an extra push besides the cultural pressure of his father's hand. Conservation runs deep in Wisconsin; many natives have grown up spending their holidays in cabins in the deep Northwoods.

Humans take a "positive" approach to deer population, according to Thomas Malthus, the 19th century British political economist and intellectual godfather of human population anxiety. He'd have been hard pressed to pick a bigger misnomer than "positive," though; by that he meant war, disease, famine, and any number of things that kill someone once they're already alive.

As with the challenges of the growing deer population, humanity must confront its own population boom in some manner. You may have heard the facts and figures by now. The U.S. Census Bureau estimates the world population on October 1 to be 6,621,694,717. Our head count increases 20 million by the end of the year. Presuming good health or good medicine sustains me until 2050, the United Nations projects that I'll be sharing the good ship Earth with more than 9 billion fellows.

In 1798, when Malthus first published the essay that made him famous at the age of thirty-two, fewer than a billion people were scattered across the surface of the Earth. Small wonder that some scoffed at him as a doomsday prophet. Actually, Malthus's point was pretty simple: the Earth doesn't get any bigger, so our ability to grow food improves only incrementally. But populations can boom in a big damn hurry, especially, as Malthus prudishly noted, since "the passion between the sexes is necessary and will remain nearly in its present state." He predicted a future worldwide famine, which fortunately didn't occur as he didn't anticipate the 20th century revolution in agricultural production.

Skeptics gloated, but that doesn't get humanity out of the woods. European and American countries, despite being a minority in global population, have managed to contribute more than their share to global pollution and resource depletion. It's been calculated that a world-full of people living the American lifestyle would need four or five earths to keep it going. With much more heavily populated countries like China and India coming into their industrial own, the picture is uncertain.

For some, it's no big deal—humans may be bound by the same finite Earth and laws of physics as deer, bugs and bacteria, but our big brains saved us from Malthus's catastrophe once, they say, and we can do it again. Maybe they're right. But one thing is more certain: our manifold problems would be greatly lessened if there were fewer of us.

The human race has taken kicks to its ego before. Science lifted the earth off its perch at the galactic center and the knowledge of natural selection dashed humanity's descent from the divine. But population control, thinning out humans much like deer, is a step further than many people are willing to consider. Our last shot at specialness is continuing our bloodline. Yet that birthright—our children—threaten their own prosperity before they're even born.

The popular images of population control tend to be draconian—from the extreme of forced sterilization to the less abhorrent but still off-putting picture of Chinese people with no practical experience of the world "sibling." Malthus himself opposed the use of contraceptives, even in marriage, because it violated "the mores of his time," according to scholar James Huzel. Two centuries later President George W. Bush pursues a policy of encouraging abstinence in Africa, which has the world's highest birth rate, in response to the mores of his time.

Women who are allowed to work have fewer children. Families with health care, who are more certain that the children they have will survive, have fewer of them. There are options, some of which probably haven't been thought of yet. They simply involve looking past the mores of your time.

Essay

Me and My Genetic Shadow

by Rachel VanCott
Scope Correspondent

Christmas in the New York of my childhood was frosted windowpanes and flannel blankets indoors. We would sit, catatonic with joy over new presents and test them out, toy horses galloping across the carpet while parents, smug at their success, snapped photographs or video-taped. One year my father tried out a live feed, straight from the camcorder to the television. He turned the camera on me, in all of my eight-year-old glory.

"Rachel, who's that?" he asked, pointing at the television screen, where a picture in picture reflected my face.

"Laura!" I said.

"No," he laughed, "That's you. Don't you see?"

When friends find out that I have an identical twin they have such enthusiastic reactions. Surely it must be fun, they say. Do you like to play tricks? Are you very much the same? Depending on the day, and my mood, my answers range from glib (yes, indeed, we have a psychic link and secret language, don't tell anyone, and for God's sake, don't poke her with a fork to test it) to the more mundane (even my parents have trouble telling us apart, and no, we've never tricked boyfriends or even schoolteachers).

It's clear from their questions that they're thinking of a clone or slave when they imagine having a twin, not understanding what it means to have a twin. Then again, I always say that I *have* a twin, never that I *am* one. I guess I don't entirely understand it myself.

Even today, no one's sure why one perfectly normal ball of fertilized cells, a zygote, resting happily in the womb decides to break and become two. The birth of identical twins is as rare as ever, only about four births in a thousand. Lately, the use of fertility drugs in the United States has caused a boom in multiple births, with mothers giving birth to twins, triplets, quadruplets, quintets, sextuplets and well, veritable litters of children. However, most of these are fraternal births, in which the mother releases multiple eggs for fertilization and the babies are no more similar than ordinary siblings; identical twins are two balls of baby matter with exactly the same DNA.

I can't explain how it trips me up to think that someone shares my DNA. It creeps up on me in little unexpected ways. One summer during my college years, I had just started a temp job at a bank, which had a policy of fingerprinting all new workers. As the security guard pressed my fingers firmly to the inkpad, I had a terrible thought.

"Um," I stammered, not sure how to phrase it, "I have an identical twin. Is that going to be a problem?"

She laughed.

"I don't think you need to worry about it," she said, "even twins don't have the same fingerprints."

They don't?

They don't. In fact, they don't even have the same DNA. Identical twins split from each other, on average, about two days after fertilization. That's the last time the two babies have exactly the same genetic code. Because of the way DNA replicates, small mutations and changes occur at random. Since the mutations occur by chance, from the moment one baby becomes two, the twins diverge. True, the differences are tiny, and rarely occur in the coding region of DNA where the change would be noticeable, so even for geneticists, it's hard to see the difference. But fingerprints are a whole different story.

The author and her sister

Fingerprints develop while babies are in the womb, and the environment of the womb varies. That difference in environment from one end of the womb to the other is enough to make it so that my sister and I have different fingerprints.

Even with the tiny differences in DNA, researchers still use twin studies to decide whether or not something has a genetic basis. If a trait appears in both identical twins, but not in both fraternal twins, it must be genetic. There are the obvious traits: eye color, hair color, skin type, height. Then the more exotic: IQ, extroversion, spacial reasoning, autism, Alzheimer's, the tendency to experience clinical depression. If one twin has it, the other probably does as well.

Every difference between us becomes a question of nature or nurture. We have our common skills. We both were talented musically, playing multiple instruments and scoring well in statewide vocal competitions. We performed well in school. Our wisdom teeth came in at the same time—crooked and we scheduled our surgeries together. Our vision is the same, terribly nearsighted, slight astigmatism. Our boyfriends both have degrees in history and are considering becoming psychologists.

I cringe at the similarities, because of the deep delicate question that naturally arises. What's the difference between us? Everything. We were the same for just one moment in time. Every moment since then has been marked by difference. Tiny incremental changes wrought by the different choices and different environments we created for ourselves.

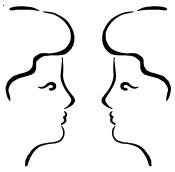
Even as scientists work to find a genetic basis for mundane human qualities, like political affiliation or economic behavior, I doubt they'll pin everything down to genetics. Life is just so much more complex than that. I have to believe it is.

My sister called recently. She's getting married and wants to lose weight before her wedding, but she needs to order the dress now. She asked me for my weight and measurements, so she could use it as a target and order a dress to fit that goal.

I balked.

"That's ridiculous," I told her, "You aren't me, you know. It's a silly idea and I can't see it working."

I kept talking, heated, bemused, and eventually I laughed and eventually, she did too.



Astronomy

The Zen of Brown Dwarf Stars

by Allyson Collins
Scope Correspondent

Beyond the windows of one sixth-floor office at the Massachusetts Institute of Technology, the clouds glow in the early-afternoon sun. But just this once, astrophysicist Adam Burgasser is unconcerned with the sky. He scans the shelves littered with physics textbooks, overlooks the unopened model-rocket launch set (an impending treat for his mechanics students), moves aside a pair of gray rollerblades to open and quickly close a cabinet, and then, dissatisfied, sits to study a flat-screen computer monitor through his silver-rimmed glasses

"After ten years, it's hard to find anything in your files," he says. "Wait, here we go." He prints one page with six columns of gray squares peppered with black dots—stars. This sheet is one of thousands that Burgasser examined between

Adam Burgasser, MIT

1998 and 2004. Through those years, first as a graduate student at Caltech and then as a postdoctoral fellow at UCLA, Burgasser was hunting for brown dwarfs—hybrid objects not massive enough to ignite as stars but typically heavier than planets. His seemingly impossible mission: to discover T dwarfs, a specific "flavor" of brown dwarfs that are very cool and hence emit little light, making them nearly invisible members of the celestial kingdom.

Burgasser stumbled upon this endeavor almost by accident. When first arriving at Caltech, he drifted among the campus laboratories and considered a number of projects. Eventually, he came upon the geological and planetary sciences department, where a researcher recruited him for the tedious work of wading through a catalogue containing images of the entire sky to find the elusive T dwarfs. The task at first seemed daunting, maybe impossible. The catalogue he was supposed to explore contained 1.3 billion objects observed in infrared light—wavelengths that neither the eye nor optical telescopes detect.

Burgasser set out to reduce that enormous collection, first by electronically eliminating objects that fell outside certain brightness and color ranges. Next he cross-referenced the database with existing optical images, presuming that an optical telescope would be unable to detect cold, faint T dwarfs. That narrowed the field to a mere 264,000 objects.

Phase two of the search consumed 10 more months—when he manually compared these remaining infrared images with their optical counterparts to confirm the electronic results.

Burgasser knew that this was a largely mindless task, not exactly the expected daily routine for a Caltech researcher. Still, he appreciated its Zen-like methodical nature and recognized the efficiency of sorting the images himself instead of spending months designing an automated program. He limited himself to one-hour intervals to spare his eyesight, periodically flagging potential T dwarfs. "It was like solving small tangible, well-defined problems," he says. "I had a little success every day."

That eyeball study gave him his final cut of 1,549 possible T dwarfs, and with that in hand, Burgasser finally was able to move from his desk to the telescope, spending nearly

60 nights observing the candidates—many of which revealed themselves to be asteroids or merely dim ordinary stars. He claimed 38 victories, though, including 2MASS 0415-0935, which held the title of the coldest-known T dwarf from 2003 until May of this year.

In astronomy, discovery inevitably transitions to analysis, so Burgasser's research has evolved from locating T dwarfs into classifying them by age, mass, behavior, and atmospheric structure. "I miss it—the search and the discovery," he says. "You can look at stars that thousands of people have observed, but to look at something no one has ever seen before…"

Essay

Cannibalize Your Life

by Allyson Collins
Scope Correspondent

"Story ideas come from the sum of your life experiences…In short, and to put it bluntly, cannibalize your life. That's what it's there for."

— Marshall Krantz, ***Ideas and Research***

Let's start with the seizure. I was ten years old and briefly lost consciousness while retrieving a ball gone astray during a game of pool volleyball in my backyard. My knees hit the grass first, then my arms, and finally my head. My body shook wildly, as if the sudden electrical change in my brain had extended to my muscles. I remember little more than feeling drenched with sweat in the backseat of the car, and then chilled by the air conditioning in the magnetic resonance imaging laboratory of the hospital. The black-and-white brain scans revealed nothing about the cause of the incident, but the experience is fodder for a science article on seizure triggers.

Moving on to fourteen years of age and a junior varsity basketball game. Yours truly, an ambitious five-foot-five-inch point guard, decided to box out the five-foot-eleven forward on the opposing team, challenging her for the rebound. I caught the ball above my head, but she yanked it from behind, and sprinted in the opposite direction with the prize—and also after tearing the cartilage that cushions the northwest corner of my shoulder blade. Three surgeries, twenty-something staples, four titanium pins, and eight total months in a shoulder sling later, I'm left with two pink scars and a story idea: the chemical and engineering considerations involved with designing implantable orthopedic devices.

And now, just a few weeks ago. Twenty-four years old. My alarm rang at 6:51 AM. My mind returned to consciousness, but my vision stayed black as I slapped the clock. Lifting my eyelids felt like bench-pressing my mattress. Starting at myself in the mirror, I was sure my eyeballs had spent the previous seven hours rubbing against the cotton sheets, or at least it looked that way. Every threadlike blood vessel in my eyes had dilated, so that tiny squiggles of red graffiti covered the white canvas of my conjuctiva, and several gray spots stained each of my brown irises.

I squinted while driving due east to work. Upon arriving, I hurried past my third-floor office and headed for the fourth-floor cornea clinic to get a professional opinion about the surface of my eyes. The diagnosis: blepharitis and marginal keratitis. The former described my swollen eyelids, and the latter depicted the gray ulcers on my inflamed corneas, both possibly the result of wearing my contacts for 16 hours a day. Brilliant move on my part, leading to a proposed article about contact lens safety and the damage caused by extended wear.

When I left Los Angeles for Boston, one of my friends wanted to send me off with a symptom-free body bought on Ebay, but that would limit my stock of story ideas. If I were healthy, I'd be forced to find a new career.

Faith is a fine invention
For gentlemen who see;
But microscopes are prudent
In an emergency.

— Emily Dickinson, c. 1880

Disease Control

Faster Test for Avian Flu in Animals Coming in 2008

by Grace Chua
Scope Correspondent

Veterinarians can soon test for avian influenza and foot-and-mouth disease on the spot, using a briefcase-sized portable testing system that works in less than ninety minutes. The old method required shipping samples of the animals' blood, phlegm, or other body fluids to an often distant laboratory, which then took five hours to produce a result, by which time infections may have spread.

The new device can run up to five independent tests simultaneously with the same kinds of samples. It can also be decontaminated on-site, making it ready to move to the next location.

The testing device, developed by UK-based Smiths Detection, could help manage disease outbreaks, said Stephen Phipson, Smiths Detection group managing director. Such outbreaks have proven fatal to people. According to the World Health Organization, the virulent H5N1 avian flu strain has claimed 203 lives between 2003 and October of this year, including a 5-year-old girl in Indonesia just last October. Losses to the hard-hit Asian poultry sector are estimated at $20 billion.

The scientific advance that makes disease control possible is a DNA processing technique called LATE-PCR, or Linear After The Exponential PCR, a variation on an established technique called PCR.

PCR is a molecular biology technique that makes large numbers of copies of DNA so that even minute amounts, such as traces from crime scenes, can be detected and analyzed. In conventional PCR, known as symmetric PCR, two primers—sequences of DNA complementary to the analyzed strand—are used to trigger the copying process and make double-stranded DNA. LATE-PCR, developed by Larry Wangh of Brandeis University in Waltham, Massachusetts, makes single-stranded DNA copies, which can be seen more easily with a fluorescent probe.

"The test is extremely sensitive," Wangh said. "If you put just a single DNA molecule in, you can get a positive signal with accuracy."

That accuracy means avian flu can be detected soon after birds are infected but before they begin to show symptoms, so potential cases can be screened earlier. In addition, the test can distinguish between the highly pathogenic, human-transmissible H5N1 strain and other strains of bird flu. The test can also be adjusted to detect H5N1 in humans. The system is expected to be in production by mid-2008.

The Smiths system is not the only one in development. United Nations Food and Agriculture Organization (FAO) spokesman Katherine Long said that the FAO is currently working on its own portable testing system for avian flu. That system, she said, is planned to be faster, lighter, and less expensive than the Smiths version. It will take 20 minutes to test for disease, will ultimately be the size of a telephone, and cost $1000 per system. However, the FAO's machines are not yet scheduled for production.

Scope

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