source of fresh genetic variability. Interbreeding may be one of the secrets to the fast evolution of Darwin's finches, the Grants suggest, adding that hybrids may be an unrecognized factor in the evolution of many other animals.

On Daphne Major the two most common species of Darwin's finches are the medium ground finch (*Geospiza fortis*) and the cactus finch (*G. scandens*). Ground finches have blunt beaks that are well suited for cracking small seeds of perennials, and larger individuals can break open the harder, larger seeds of a plant called the caltrop. The cactus finches have pointier beaks that they use to devour the fruits and pollen of cactus.

Changes in the food supply have made natural selection favor birds with beaks of certain sizes and shapes at different times, the Grants have demonstrated—just as Darwin theorized. In 1977 a La Niña–related drought wiped out the plants that produce small seeds, and most of the ground finches died. But some big-beaked birds survived because they could feed on caltrop seeds. Within a few generations, the average ground finch beak evolved to be 4% bigger. But in 1983 the island was clobbered by La Niña's soggy twin, El Niño, whose rains triggered a frenzy of small-seed plant growth. Ground finches with small beaks were more efficient at eating the new seeds and had more offspring, shrinking the average beak by 2.5% within a few years.

Cactus finches have evolved as well, although natural selection has acted more weakly on them. When the 1983 El Niño swamped the birds' favored cactuses, birds with slightly blunter beaks could eat the small seeds of other plants. But the Grants found a paradox: Cactus finch beaks have been getting significantly blunter year after year, even though selection pressures from the birds' food source have diminished.

The reason, the Grants found, is that cactus finches have been fraternizing with ground finches—and the latter's genes are shaping the former's beaks. After the 1983 floods, female cactus finches starved as the larger males drove them away from the few remaining fruits. That left as many as five male cactus finches for every female. A few desperate males mated with female ground finches, which then produced perfectly healthy and fertile hybrids. These hybrids only mate with cactus finches, because they imprinted on the songs of their cactus-finch fathers. "The sons will sing the same song as the fathers sing, and the daughters, having paid attention to the songs of their father, will pick a cactus finch male when they grow up," Peter Grant explains. As a result, ground finch genes are flowing into the cactus finch gene pool—a process called introgression—making their beaks blunter.

Other biologists are surprised that two distantly related species can produce healthy hybrids that go on to play an important evolutionary role. Introgression is "something that's invisible unless you do work like the Grants have been doing for so long," says David Reznick, a biologist at the University of California, Riverside. "It may turn out to be much more important than people think."

This new source of genetic diversity makes it easier for a species with donated genes to adapt to a changing environment, the Grants claim. At the same time, introgression of the finch genes demonstrates just how leaky the barriers are between species. "It forces people to think of species much more as open genetic systems rather than closed ones with an impermeable membrane," says Peter Grant.

As for the finches' future, the Grants can say only that it promises to be as unpredictable as the past. Will *G. scandens* disappear as it acquires more and more *G. fortis* genes? "I think the fusion is taking place right now," says Peter Grant. As evolution unfolds on Daphne Major, the Grants and their students will be watching.

–CARL ZIMMER

Carl Zimmer is the author of *Evolution: The Triumph of an Idea.*

DEFENSE SCIENCE

Jason Hooks Up With New Sponsor

An exclusive group of academic scientists is moving up the Pentagon food chain and will soon resume a 40-year flow of unvarnished technical advice to the U.S. government.

One month after the Defense Advanced Research Projects Agency (DARPA) acknowledged dropping its support of Jason (*Science*, 29 March, p. 2340), the group is nearing completion of a similar arrangement with the higher ranking Director of Defense Research and Engineering (DDR&E). The new relationship comes just in time for the next planning meeting of the self-selected group of scientists, who produce often-classified studies on a variety of issues. "It's important to have academics helping [the defense department] address tough problems," says Delores Etter, a former acting head of DDR&E who is now at the U.S. Naval Academy in Annapolis, Maryland. "Even more so since 9/11."

The ties between Jason and the military, formed in the wake of Sputnik, were severed last December after DARPA officials concluded that Jason had not kept up with the times and that its studies focused too heavily on physics. Jason disputed that assessment, noting that a third of its members were not physicists and citing recent studies ranging from modeling biological systems to building computers with molecular electronics. The

ScienceScope

De-Celeration Biotechnology's enfant terrible—Celera Genomics in Rockville, Maryland—is mellowing with age. Last week, it formally disavowed its youthful aim of becoming a worldwide purveyor of genome news and data, a goal once proclaimed by founder and former president J. Craig Venter, who left the outfit abruptly in January. Instead, Celera is morphing into a drug R&D firm and will operate primarily as a data provider to its parent organization, Applera Corp. of Norwalk, Connecticut.

Applera CEO Tony White announced on 22 April that an executive from within the company, Kathy Ordoñez, is being promoted to serve as president of both Celera Genomics and a subsidiary called Celera Diagnostics. White explained that an internal study concluded that the company could not profit in the long term by selling only data. So Celera's services will be combined with an online reagent and equipment supply operation to be known jointly as the Applied Biosystems Knowledge Business. White called it "a complete transformation."

Wilson Resigns Prominent gene therapy researcher James Wilson (below) will resign as director of the University of Pennsylvania's Institute for Human Gene Therapy in Philadelphia. The decision, announced last week by Penn officials, comes 31 months after the death of an institute research subject sparked intense scrutiny of the institute's procedures and widespread debate about the adequacy of human subject protections.

The September 1999 death of patient Jesse Gelsinger prompted federal officials to shut down eight gene-therapy trials at the institute and to consider stripping Wilson of authority to oversee research involving human subjects (*Science*, 12 May 2000, p. 951). Wilson's troubles—and gene therapy's dimming promise—prompted an internal Penn committee to conclude that the $13 million institute should "broaden its scientific focus to include cell-based therapies, as well as stem cell biology and molecular virology," according to an e-mail sent to faculty members last week by medical school dean Arthur H. Rubenstein. The memo's contents were first reported by *The Philadelphia Inquirer*.

Wilson could not be reached for comment. In his e-mail, Rubenstein said Wilson will resign 1 July but will remain at Penn as a researcher and professor.

CREDIT: SAM KITTNER

real reason for the split, say Jason members, was that the group had rejected three members proposed by DARPA whom Jason saw as unqualified. Stripped of its DARPA support, which constituted nearly half of its budget, Jason was forced to cancel its 2-week winter study. Members privately fumed that their specialty—inventing and advising on technological wizardry such as non–Global Positioning System methods of geolocation and counterterrorism devices—was particularly valuable in the current geopolitical situation.

DDR&E—the umbrella for all defense research, including DARPA and each military service—helped set up Jason, says Will Happer, a physicist at Princeton University and a former head of Jason. "So we're back to our roots," he says.

The contract is expected to be completed by 1 May, and DDR&E officials have declined to comment beforehand. But DDR&E is said to be willing to almost match DARPA's $1.5-million-a-year contribution and serve as a conduit through which Jason's other clients—including the Department of Energy and the intelligence community—can funnel money and requests for studies.

The nature of those studies is likely to remain technical, not policy-oriented. "We're not a policy organization," says Jason's chair, Steven Koonin of the California Institute of Technology in Pasadena, "we just ain't." But Happer and Gordon MacDonald, a Jason senior adviser, say Jason's new home might boost its visibility. "More of Jason's recommendations could get the Pentagon's serious attention," says MacDonald.

This weekend's spring planning meeting will take place as scheduled, MacDonald says, although members will have to pay some of their own expenses. Koonin also expects the 6-week summer study to proceed as planned. "We may have taken a little hit on our cohesion," he said, "and maybe we've lost a little momentum. But we've got a full plate of topics for the summer."

—ANN FINKBEINER

Ann Finkbeiner is a science writer in Baltimore, Maryland.

GENETICS

One Gene Determines Bee Social Status

Taking a cue from their colleagues studying fruit flies, honey bee researchers have pinned down a gene responsible for a key aspect of the sophisticated lifestyle of this social insect. Although they lack the brainpower of higher animals, bees and other organisms nonetheless exhibit quite complex behaviors. In the hive, for example, honey bees divvy up work, with females assuming different roles as they age, first tending to the young as nurse bees and later heading out to gather nectar and pollen for the queen and their nestmates.

Gene Robinson, an entomologist at the University of Illinois, Urbana-Champaign, and his colleagues report on page 741 that stay-at-home bees turn into foragers when a gene called *for* turns on. The gene is best known for its role in mediating fruit fly behavior—specifically, how actively a fruit fly seeks out food. "It's pretty remarkable that the same basic gene influences honey bee behavior in the same way that it does in fruit flies," comments Fred Gould, an entomologist at North Carolina State University in Raleigh. But *for* plays a much more complex role in bees than in fruit flies, controlling behavior during their development and, consequently, influencing their place in the hive's hierarchy.

Lot in life. Whether a honey bee tends the hive or collects nectar depends on one gene's activity.

Co-author Marla Sokolowski, a behavioral geneticist at the University of Toronto, Ontario, was the first to track down *for*, doggedly pursuing it for 15 years after noticing that some fruit flies were consistently lazier than others. It joined several other genes known to affect behavior in the lab—and more importantly, with *for*, Sokolowski was the first to show a gene that influenced behavior in the wild as well. In the so-called sitters, she found, the gene is less active than it is in their more energetic colleagues. It may be that slight differences in the gene's sequence cause variations in its activity, Sokolowski suggests, resulting in behavior that varies from fly to fly (*Science*, 8 August 1997, p. 763).

To find out whether *for* might play a role in the bee's developmental change from nurse to forager, Yehuda Ben-Shahar, a graduate student in Robinson's group, isolated the bee version of the gene and checked for its activity in the brains of both stay-at-home and food-gatherer bees. His approach "is an example of how biologists starting at the behavioral level are working down to the level of activity in genes," says Thomas Seeley, a behavioral biologist at Cornell University in Ithaca, New York.

Ben-Shahar and his colleagues found that the gene was more active in forager bees, just as it is more active in wide-roaming fruit flies. And that enabled Robinson and colleagues "to test our hypothesis in a more rigorous way," he says.

One possibility, for example, could be that older bees simply express more *for*, and the gene has little to do with switching jobs. To test this scenario, the researchers made an artificial colony in which all the bees were just 1 day old. Because there were no older foragers, some of the young bees left the hive in search of food 2 weeks earlier than they would have if they lived in a natural colony. These precocious foragers showed greater *for* activity than their more sedentary peers, the team found. In other words, age doesn't matter.

The Illinois group also looked at protein activity. The *for* gene codes for a cell-signaling molecule called a cyclic GMP-dependent protein kinase (PKG). When Ben-Shahar and colleagues treated other young bees with a chemical that stimulated PKG activity—similar to what would happen if the gene became more active—the bees were much more likely than control bees to start foraging, they report. There was no change in behavior when the researchers treated bees with a similar chemical that did not affect the protein's activity.

"They've connected the [*for*] gene to one of the biggest questions in social insects: how the work is divided up," comments Jay Evans, an entomologist at the U.S. Department of Agriculture Bee Research Lab in Beltsville, Maryland. Given that the gene affects behavior similarly in both bees and fruit flies, the work "gives more support that evolution solves a problem and keeps that solution in a wide variety of species," says Charalambos Kyracou, a molecular neurogeneticist at the University of Leicester, U.K. He and others expect that researchers will intensify their study of *for* in other species. Gould thinks the work may have an even broader impact: "My sense is [the finding] is going to give people more optimism about finding more of these behavioral genes."

—ELIZABETH PENNISI

CREDIT: Y. BEN-SHAHAR *ET AL.*