tionary biologist Richard Shine of the University of Sydney in Australia. Larry Wolf, a behavioral ecologist at Syracuse University in New York, adds that researchers have long thought that carib bills might closely match their favorite flower's shape. "Now someone has actually gone out and shown it," Wolf says. "That's pretty neat."

Across the wild kingdom, of course, animals compete for food. And Charles Darwin long ago suggested that food competition could cause, or maintain, different male and female hummingbird bills. But the scientific evidence has remained scanty. Most evolutionary studies explain male-female differences by sexual selection. Male peacocks, for instance, grow flashier plumes than females in order to attract mates. By comparison, few studies have shown that the sexes might, when faced with a new environment, evolve differently in order to divvy up food. One unappreciated example may be mosquitoes: In some species, male mouthparts pucker perfectly to slurp nectar, whereas female mouthparts are specialized for sucking blood. Some water snakes, too, have varying head sizes for swallowing lunch.

The purple-throated carib makes a prettier case study, with its small, black body tucked inside iridescent emerald wings. "Sitting in the rainforest," says Temeles, "you see this gorgeous glittering green just shooting through the canopy." And he's had plenty of time to see it. Last summer, Temeles and three students hiked through four rainforest reserves on St. Lucia. To see whether male and female caribs dined differently, they spent 4 weeks watching the birds at distinct patches of *Heliconia* plants. A pattern soon emerged: 15 of 15 males fed on patches of *H. caribaea*, whereas 11 of 18 females chose *H. bihai* instead. The birds are the sole pollinators of these plants.

To learn how closely the carib bills and their favored flowers fit, the team measured both. The male birds sport short bills that curve down at a slight 15° angle. Their preferred flower, *H. caribaea*, averages just 38 mm long and curves out at about 21°. By contrast, the bills of female caribs are 30% longer than male bills and curve down twice as much, at a 30° angle. Accordingly, their favored flower, *H. bihai*, averages 44 mm long, with a 31° curve. What's more, Temeles says, both male and female caribs feed more quickly—and presumably efficiently—at the flower that best matches their bill. Bolstering the case, notes Temeles, in some rainforest areas, another plant has essentially replaced *H. caribaea*, again attracting male birds with its similarly shaped flowers.

How, exactly, did the hummingbirds evolve such pointed differences? Temeles speculates that thousands of years ago, when hummingbirds first arrived on St. Lucia, the larger, dominant males probably favored *H. caribaea*, a plant that bears more flowers. That left females with the less effusive *H. bihai*. Over time, Temeles says, the bills of both male and female caribs have adapted to fit their flower of choice, enabling the birds to make the most of their food source. "Food is really running the show," he suggests, although he cautions that biologists can never really know what, exactly, kick-started a chain of evolutionary events so long ago.

There's more to learn from these birds and blossoms, Temeles says. Does this hummingbird-*Heliconia* relationship hold up season after season? What about on other islands? And how have the flowers also evolved, welcoming caribs with just the right curves? Hunting for answers, he intends to return to the West Indies next summer.

–KATHRYN BROWN

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TOXICOLOGY

Mercury Report Backs Strict Rules

The debate, finally, seemed to be settled. After an 18-month review, a panel of the National Academy of Sciences (NAS) last week weighed in on the health risks of mercury, endorsing strict safety levels adopted by the Environmental Protection Agency (EPA) in 1995. But already some scientists are contesting the panel's conclusions, and federal agencies are grappling with how to reconcile competing regulations.

Released largely from coal-burning power plants, mercury is converted by bacteria to a form called methylmercury that accumulates in the aquatic food chain. Humans are exposed when they eat fish. Although the neurotoxic effects of methylmercury are well

CREDIT: KEN HAMMOND/USDA

Fishy findings? Experts can't agree on the risk of eating fish containing mercury.

ScienceScope

Defining Distress The U.S. Department of Agriculture (USDA) is asking for help in developing a better system to document the pain and distress experienced by lab animals. In a 10 July *Federal Register* notice, USDA's Animal and Plant Health Inspection Service (APHIS) notes that many critics consider the current system "outdated and inadequate." Among the flaws: no definition of "distress" and no scale to measure the intensity or duration of pain. APHIS is asking concerned outsiders to study pain classification systems used elsewhere and suggest how to modify existing rules. "Change is coming," a USDA official predicts. Comments, however painful or distressing, are due by 8 September.

Boom Times U.K. scientists can look forward to 3 years of prosperity. A government-wide spending plan announced on 18 July gives the Office of Science and Technology a budget boost averaging 7% per year for the years 2001–04. In addition to increases for grad student stipends and stemming lab decay (*Science*, 14 July, p. 226), the plan calls for spending more than $100 million to commercialize university research. The various research councils are now vying for their shares of the spending, which will be decided in the next few months.

Environmental Royalty A proposal to create a science czar at the U.S. Environmental Protection Agency (EPA) is winning support from Congress and even the agency itself. Last month, a National Academy of Sciences panel recommended creating the position to bolster EPA's use of science (*Science*, 16 June, p. 1943). Now, Congress and the Administration seem to be listening.

At a House subcommittee hearing last week, Representative Vernon Ehlers (R–MI) announced that he's drafting legislation to create the deputy-level science position and institute other recommendations, such as one to set a 6-year term for the head of EPA's Office of Research and Development. Says Ehlers: "Scientists need more clout." In the Senate, George Voinovich (R–OH) has told EPA chief Carol Browner that he foresees similar legislation. And EPA deputy administrator Michael McCabe wrote Congress that the agency likes the report, too. "Perhaps most significantly, we agree" with creating the deputy science position, he wrote. But don't look for anything to happen quickly because of a packed congressional calendar and the need to navigate any bill through several committees.

known—it can cause sensory and motor problems in adults and mental retardation and other effects in children exposed to high levels in the womb—scientists have argued for years about whether low levels are harmful. Five years ago, EPA sparked a controversy when, citing data from a 1971 poisoning incident in Iraq, it proposed reducing the safe level for mercury exposure to 0.1 micrograms per kilogram of body weight per day. That decision put EPA at odds with other federal agencies, such as the Food and Drug Administration (FDA), whose standard was five times higher.

Critics from industry and other agencies jumped on the EPA decision. They argued that the agency should rely on new studies of mercury's low-level effects, and when EPA did, they challenged its interpretation of those studies. The debate revolves around dueling findings.

The critics cite a study that has found no damage to neurological development in 700 5 1/2–year-olds born to mothers who ate mercury-contaminated fish in the Seychelles Islands in the Indian Ocean. The latest results of this ongoing study were published in 1998. EPA, in turn, has relied on a Danish study of children in the Faroe Islands in the North Atlantic, which did find neurological harm at low-level exposures. The critics contend that this study is flawed because the mercury-tainted whale meat that the Faroe islanders ate also contained polychlorinated biphenyls (PCBs) and other pollutants known to affect neurodevelopment. But EPA stuck by its analysis. "We concluded PCBs were not the basis" of the effect, says Kate Mahaffey, then EPA's lead scientist on mercury risk assessment. When scientists couldn't agree on which study was more reliable, Congress requested the academy report.

To the critics' surprise, the NAS panel placed more faith in the Faroe Islands study. At the panel's request, the Danish investigators excluded the data for children who were also exposed to high PCB levels; the remaining subjects still showed neurological effects from exposure to low levels of mercury, says retired pathologist Robert Goyer from Chapel Hill, North Carolina, who chaired the committee. "We're not really clear why the Seychelles Islands [study] is different, but we feel very confident in the [Faroe Islands] results," says Goyer—especially because a recently published New Zealand study also found low-level effects.

"We're very pleased by the support the academy has given to the scientific justifiability of EPA's [proposed standard]," says Mahaffey. But critics are underwhelmed. "We're very disappointed," says neurologist Gary Myers of the University of Rochester in New York, a member of the Seychelles study team. Myers and others—including a scientist at the Department of Health and Human Services who spoke with *Science*—argue that, although they haven't yet read the NAS report, any attempt by the Danish researchers to separate the effects of PCBs was questionable because they didn't adequately measure exposure to PCBs and related pollutants in the first place. And they fault the New Zealand study, which involved about 200 children, in part for being too small.

Alaska state epidemiologist John Middaugh and other critics say they don't oppose EPA's plans to clamp down on industrial mercury emissions. But they worry that communities that depend on fish for their primary source of protein may stop eating fish. That would be counterproductive, they say, as the benefits of eating fish on developmental and cardiovascular health may outweigh the risks (*Science*, 12 December 1997, p. 1904). FDA and other agencies must now decide whether to adjust their safety levels for mercury. They say they plan to weigh all the evidence—including the latest results, expected in 2001, from the Seychelles children.

–JOCELYN KAISER

DEVELOPMENTAL BIOLOGY

Why Chicks Aren't All Thumbs

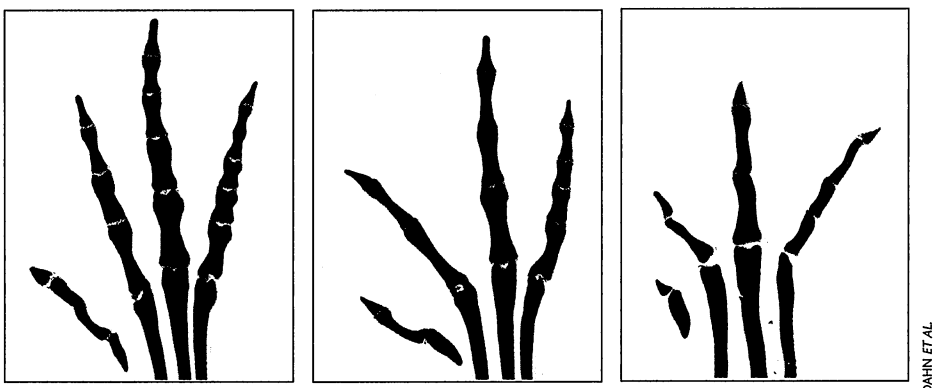
Imagine what it would be like trying to play the violin or eat with chopsticks if your fingers were all thumbs. Having fingers and toes of various sizes is not only handy, but also has allowed humans to conquer nearly every ecological niche on our planet. Just why a pinkie becomes a pinkie and not another thumb, however, has puzzled developmental biologists for decades. Now a new study on page 438 offers some surprising insights on when and how digits assume their distinctive shapes.

Scientists had thought that even before cartilage cells begin to develop into a finger or toe, they already know what shape digit to make. For example, cells that will form the second digit on the hand know that they should become an index finger rather than a thumb or pinkie. The new findings, however, suggest that digit identity is programmed much later in development, by chemical messengers from the surrounding tissue. "Nobody anticipated that the positional information does not reside within the digit precursors," says developmental biologist Clifford Tabin of Harvard Medical School in Boston. Because in most animals the cells of this webbing die off before birth, the new study, says Denis Duboule, a developmental geneticist at the University of Geneva in Switzerland, "demonstrates that these cells have a real function and are not simply remnants of evolution."

Chicken feet are what tripped up the decades-old single-step model of digit formation. Employing novel microsurgical techniques, developmental biologists Randall Dahn and John Fallon of the University of Wisconsin, Madison, manipulated embryonic chick limbs. The unusual anatomy of chicken feet was key to their experiments. "The nice thing about the chick foot," says Dahn, "is that all four digits have a different length and a different number of phalanges," or segments, which can be used to identify them.

If location meant identity, the researchers reasoned, then bisecting a developing third digit on a chick's foot should result in a chick with two third digits. The researchers tested this idea by puncturing eggshells and using watchmaker tools to imbed foil barriers in the center of the tiny digit precursors of the embryos. They covered the holes with clear tape and watched what happened. "What we got was very surprising," says Dahn, who for simplicity's sake uses human nomenclature to describe chick digits. "When we bisected a middle finger [precursor]," the half next to the index finger would become another index finger.

The researchers speculated that the webbing might be instructing the digit cartilage cells how to develop. And indeed, when Dahn and Fallon attached an index precursor between the ring and pinkie precursors, the transplanted digit that developed had the same



BMP's fingerprint. Boosting BMP levels spurs extra digit segments *(left)*, while reducing levels results in fewer *(right)* compared to normal chick foot *(center)*.

CREDIT: R. DAHN *ET AL.*