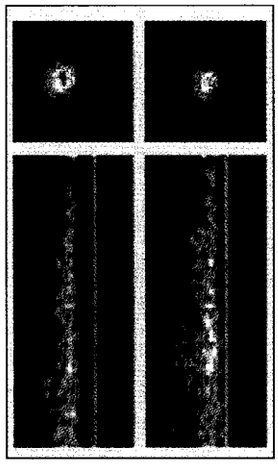
ATOM OPTICS

Attractive Wire Guides Atoms Out of Trap

It's not easy to manipulate individual atoms. For a start, you must confine them in a magneto-optical trap—a device that holds a small cloud of atoms in a magnetic field and cools them down to almost absolute zero—and then your options are still pretty limited. The most researchers have been able to do is to tweak the trap's magnetic field to move the atoms around, allow them to drop under gravity, or kick them out with pulses of light (see p. 1611). But now, researchers at Innsbruck University in Austria have gained a new mastery of atoms with current-carrying wires that can guide atoms just as optical fibers guide light.



Riding the tube. Atoms caught in magnetic field tube next to current-carrying wire.

The technique, described in the 8 March issue of *Physical Review Letters*, could be used in small nanostructures that would manipulate atoms as handily as integrated circuits guide electrons. Ultimately such "atom optics" might even provide components for quantum computers. This research is a "step in the right direction" toward the creation of integrated atom optics, says physicist Wolfgang Ketterle of the Massachusetts Institute of Technology.

The Innsbruck researchers, led by physicist Jörg Schmiedmayer, took advantage of the small magnetic field that atoms gain from the quantum mechanical "spin" of their electrons. An atom is repelled by an external magnetic field if it is parallel to its own and attracted to one that is antiparallel. So the researchers took some cold lithium atoms from a trap and nudged them in the direction of a current-carrying wire that generates its own magnetic field, looping around the length of the wire. Any approaching atoms with a magnetic field antiparallel to the wire's get caught up in this field and begin to orbit the wire. If they also have momentum parallel to the wire, they will spiral along it, guided by the magnetic field.

There are not many circumstances when you can spiral atoms down a free-floating wire, so the team also attempted a slight variation on the technique. They superimposed an additional magnetic field across the wire that has the effect of canceling the wire's field on one side, creating a "tube" of field parallel to the wire that has a minimum in its center. Atoms whose parallel field would normally be repelled by the wire can get trapped in the region of low field and channeled along the tube next to the wire. The team was able to take pictures of the atoms following the wire by briefly illuminating them with lasers, causing them to luminesce.

This side-guiding technique is particularly appealing to atom opticians because it could allow them to construct wires on a surface and, with the help of an external magnetic field, channel atoms along specific paths just above the surface. Says Schmiedmayer: "You could mount the side-guide wire on a surface and use nanofabrication technology to produce very small wires and structures," devices that might serve as the hardware for a quantum computer. "In fact, we are trying to make such small structures now." Ketterle adds that the Innsbruck group isn't the only one developing techniques to guide atoms. "There are quite a few efforts made now to use magnetic fields, wires, miniaturized permanent magnets, and laser light to build new traps, new guides, and new mirrors for atoms," says Ketterle.

–ALEXANDER HELLEMANS

Alexander Hellemans is a writer in Naples, Italy.

BIOPROSPECTING

Model Indian Deal Generates Payments

NEW DELHI—A native community and an Indian research institute this month will collect the first payment from a landmark agreement to market a herbal tonic derived from a local plant. The agreement is seen as a model for so-called bioprospecting efforts endorsed by the 1992 Convention on Biological Diversity.

The medicine is based on the active ingredient in a plant, *Trichopus zeylanicus*, found in the tropical forests of southwestern India and collected by the Kani tribal people. Scientists at the Tropical Botanic Garden and Research Institute (TBGRI) in Trivandrum, Kerala, isolated and tested the ingredient and incorporated it into a compound, which they christened "Jeevani"—giver of life. The tonic is being manufactured by the Aryavaidya Pharmacy Coimbtore Ltd., a major Ayurvedic drug company.

The process marks perhaps the first time that cash benefits have gone directly to the source of the knowledge of traditional medicines, says Graham Dutfield, an ecologist with the Working Group on Traditional Resource Rights at the University of Oxford, U.K. "It is a replicable model because of its simplicity," he says about a chain of events that began well before the international biodiversity treaty was signed.

TBGRI scientists learned of the tonic, which is claimed to bolster the immune system and provide additional energy, while on a jungle expedition with the Kani in 1987. A few years later, they returned to collect samples of the plant, known locally as arogyapacha, and began laboratory studies of its potency. In November 1995, an agreement was struck for the institute and the tribal community to share a license fee and 2% of net profits. Another agent from the same plant is undergoing clinical tests for possible use as a stamina-building supplement for athletes.

The first $21,000 payment, to be shared by the tribal community and the institute, is due later this month. P. Pushpangadan, until last month the institute's director, predicts that the deal will "not only generate mass employment but also be a money spinner for the poverty-stricken tribals." He compares its potential value to the booming market for ginseng, cultivated in Southeast Asia.

But some scientists are skeptical of such claims, and a few even question the agreement's underlying principles. Dan Janzen, an ecologist at the University of Pennsylvania, Philadelphia, who works in Costa Rica and helped broker a deal between the government and Merck for bioprospecting there, calls it a "publicity and political move by the participants, the benefits of which may disappear within a few years." Although he acknowledges the value of drug search and discovery in the wild, he deplores a mindset that assumes the "produce of those at some lower class" should be readily available for exploitation "by the decision-makers of a given society."

Rich harvest. A team led by P. Pushpangadan, left, helped develop a popular tonic from an extract of India's arogyapacha plant.

CREDITS: (TOP) *PHYSICAL REVIEW LETTERS* 82 (10), 2014 (1999); (BOTTOM) TBGRI

Pushpangadan, now head of the National Botanical Research Institute in Lucknow, disagrees, saying that he would not have fought against the odds for 12 years unless he was sure that the arrangement would benefit the Kani. And botanist Peter Raven, director of the Missouri Botanical Gardens, considers this agreement a "very good model for future" partnerships throughout the developing world. The current agreement must be renegotiated in 7 years, and the tribal community is expected to use the money for health care facilities and schools.

–PALLAVA BAGLA

DEVELOPMENTAL BIOLOGY

New Findings Reveal How Legs Take Wing

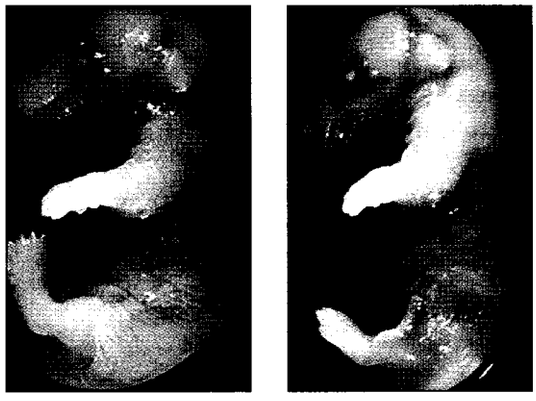
It doesn't take training at Kentucky Fried Chicken to know the difference between a chicken wing and a leg. But it's taken researchers a long time to figure out the molecular signals that tell the developing embryo which kind of limb to make. Now, work from at least four labs points to a set of proteins that appear to play a leading role in separating legs from wings.

In the past decade, developmental biologists have made impressive progress in identifying the genes that control a limb's growth from trunk to tip and from front to back. But almost all of those genes turned out to be the same in both arms and legs. That left researchers wondering just what genes control the many shape differences between the limbs. "To identify the genes that convey 'legness' is amazing," says developmental biologist Cheryll Tickle of the University of Dundee in the U.K., who has helped uncover many of the embryonic genes that structure the limbs.

The first clues came last year, when several groups reported that in a number of vertebrates, at least three genes are expressed only in either forelimbs or hindlimbs. *Pitx1* and *Tbx4* are found in the legs, while *Tbx5* is expressed in wings and arms.

Suspecting that these genes might help differentiate the limbs, several groups began to examine their effects in embryos, and results are now rolling in. Last month, developmental biologists Juan Carlos Izpisúa Belmonte of the Salk Institute for Biological Studies in La Jolla, California, and Michael Rosenfeld of the University of California, San Diego, and their colleagues reported in *Genes and Development* that in genetically engineered mice lacking the leg-specific *Pitx1*, the hindlegs have short, thin bones that resemble forelimbs. Although the animals' fore- and hindlimbs are not identical, there is "an element of armness that's come to the leg," says Rosenfeld.

The opposite experiment—expressing *Pitx1* in the wings of developing chicks—seems to bring a bit of leg to the wing, as Izpisúa Belmonte and Rosenfeld reported, and as Clifford Tabin and Malcolm Logan of Harvard Medical School in Boston now report on page 1736 of this issue. To express *Pitx1* in the forelimb, Tabin and Logan inserted the gene into a virus and then infected the chick embryonic region destined to become the wing bud. Although the wing was not completely transformed, the results were striking. Chicken wings normally bend downward at the equivalent of the wrist, but in the infected wing the bones grew straight, similar to the junction between a chicken's ankle and foot. The affected wings did not grow feathers and often sprouted claws. (Izpisúa Belmonte and Rosenfeld's experiments yielded similar results.) Logan and Tabin also found changes in the chick's muscle structure: Infected wings developed the four muscles characteristic of the chicken drumstick, but lacked the usual seven wing muscles.



On the other hand. A mouse embryo lacking the *Pitx1* gene (*right*) forms short, slender, armlike hindlimbs.

Pitx1 apparently doesn't produce these changes alone; it seems to exert its influence by turning on another leg-specific gene, *Tbx4*. In infected wings, Logan and Tabin found the *Tbx4* gene turned on wherever the *Pitx1* gene was active. *Tbx5*, the forelimb gene, was also active, however, which may explain why neither group found complete transformations from wings to legs.

At the Nara Institute of Science and Technology in Japan, developmental biologist Toshihiko Ogura and his colleagues have found even more dramatic transformations by working with *Tbx4* and *Tbx5*. Ogura declined to discuss the as-yet-unpublished work, but those familiar with the study, such as Sumihare Noji of the University of Tokushima, who heard Ogura pre-

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ScienceScope

Road Kill When students change schools often, math and science can get lost in the shuffle. That's the message from the National Science Board (NSB), which has just issued a report on improving the poor performance of U.S. students (see p. 1616). "The importance of [student] mobility hasn't been recognized" in the current push for national standards on curricula, says NSB chair Eamon Kelly, citing studies that show nearly one-third of U.S. eighth graders have changed schools two or more times. Low-income students are more likely to move frequently, he adds, a factor that could exacerbate the achievement gap between minorities and whites.

In other recommendations, the report, "Preparing Our Children" (www.nsf.gov/nsb), proposes a national campaign to improve instructional materials and teacher preparation as well as strengthen links between academic researchers, K-12 teachers, and school districts. Kelly admits that the suggestions aren't new, but says the board hopes to "raise the consciousness" of policy-makers and the public on the subject.

Trouble for IT²? Representative James Walsh (R–NY) is making it clear that he doesn't like the politics behind IT², the $366 million information technology initiative trumpeted by the Clinton Administration (*Science*, 29 January, p. 613).

At a hearing last week, Walsh gave the National Science Foundation–led effort credit for being "much more focused" than NSF's previous program to make computer networks faster and more user-friendly, dubbed Knowledge and Distributed Intelligence. But he is concerned about "NSF's ability to act independently and not just follow orders from the White House" when it comes to spending its $144 million share of the six-agency initiative. The words from Walsh, who chairs the House panel that oversees NSF's budget, suggest that IT² could face problems if money is tight.

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