Abstractions

PENULTIMATE AUTHOR

Hair cells in the cochlea allow us to hear by converting sound waves into electrical impulses. But how they do this, and the molecules that govern the mechanics of the process, is not known. Ulrich Müller at the Scripps Research Institute in La Jolla, California, and his colleagues define a key hair-cell structure on page 87. He spoke to *Nature* about unravelling mechanotransduction.

We've had molecular descriptions of vision for some time, why not for hearing?

Vision, taste, smell and pain all rely on the action of ion channels, which have been well characterized. Hearing and touch rely on mechanically gated channels. At the tip of each hair cell is a bundle of stereocilia. The leading model posits that these are connected to each other by structures known as tip links, and that when tip links are deflected by sound pressure they exert a force that opens a spring-gated channel. But the molecules making up the tip link, spring and channel were unknown. We identified two molecules — cadherin 23 and protocadherin 15 — that interact to form tip links.

Why has tip-link structure been so elusive?

Because there are so few hair cells, their components cannot be purified using classical biochemical techniques. And tip links are so small that they are at the limit of microscope resolution.

What inspired you to search for the tip-link components, and where did you start?

Deafness is the most common form of sensory impairment in humans, yet our mechanical senses are the least well understood. We started by looking at genes linked to deafness, such as those for cadherin 23 and protocadherin 15, because it was possible they encoded components of the mechanotransduction machinery.

Where else is mechanotransduction important?

Mechanical phenomena occur throughout the body, having roles in features as diverse as posture, blood-pressure control and embryonic development. Understanding mechanotransduction is a major challenge. Knowing how biological components fit together and which are static and elastic has applications for nanotechnology and engineering.

What attracted you to hair-cell research?

The sheer beauty of these cells is amazing. I am also fascinated by their potential for mapping circuits in the brain. We know all the frequencies that stimulate these cells, so we can ask how a sound elicits a state of anxiety, fear, or joy in an animal. ■

MAKING THE PAPER

Phil Cummins

Combining historical accounts and geology to estimate tsunami risk.

Just a few months before the Indian Ocean tsunami of 26 December 2004, Phil Cummins forecast that such an event could result from a giant earthquake in central Sumatra. The Geoscience Australia seismologist's prediction, made in the organization's September newsletter, was accurate in all but one aspect: the magnitude-9.0 quake happened in northern Sumatra.

"I assumed it would take years to build a case and draw the attention and resources needed to study the area in detail," says Cummins, who is leading Australia's effort to assess tsunami risks from the Indian Ocean. But the 2004 event boosted interest and since then, he says, "the human cost has become an overwhelming motivator for my work. It is a moral obligation."

Unfortunately, he has little tangible evidence to build on. Geological surveys of the Indian Ocean are scarce, and those that are carried out are often done by petroleum geologists, so aren't focused on potential hazards. The limited monitoring of the region means that it is difficult to detect the surface-stress movements that precede a large quake. As a result, Cummins has spent several years combing historical accounts for indications of past tsunamis.

He tracked down as many accounts as he could find. Most had been made by British colonialists or merchants. One event stood out — an earthquake in 1762 at the northern tip of the Bay of Bengal. This area is difficult to study, because a 20-kilometre-thick layer of sediment streams down into it from the Himalayas. Most scientists presumed this fault to be inactive, because the direction of maximum stress is not aligned with the direction of deformation — or physical strain — as is typical. Most believe the region's greatest earthquake risk to be the fault running through central Myanmar.

But Cummins has combined historical and geological evidence to support the potential for a giant earthquake and tsunami hazard in the Bay of Bengal (see page 75). He cites observations of a British ship commander, made during a land survey in 1841, that detail evidence of a previous sudden uplift along the bay's southern coastal islands. Letters from Bangladesh's seaport city of Chittagong in the 1760s provide further evidence, describing a violent ground motion and fallen buildings. This suggests the area could be the northernmost portion of the fault.

These accounts convinced Cummins that a stretch of coast at least 700 kilometres long could have ruptured in 1762. "To produce a giant earthquake and tsunami you need to rupture a large, homogenous surface — which could be formed by the accumulated sediments," he says.

Scientists have long used historical accounts to corroborate science, but have yet to exploit the information available for the Indian Ocean, says Cummins. There are probably other records, he adds, particularly in the non-English literature, that would prove valuable to review. He hopes that scientists will set their sights even further back in time. "The most important thing we can do now is systematically study all of the world's subduction zones for geological evidence of prehistoric earthquakes and tsunamis," he says.

Cummins can surmise that a giant earthquake and tsunami is plausible in the northern Bay of Bengal, but he can't pin-point when such an event — which would endanger 1 million lives — might arise. He hopes his past success in predicting specific tsunami risks will help stimulate further study of the region. ■

FROM THE BLOGOSPHERE

'What's an author?' asks Robin Rose of Oregon State University on Nautilus (http://tinyurl.com/34qvmo). Commenting on a *Nature* paper with 21 authors, he lists ten questions that address the validity of authorship. Nature journals do not specify a particular order or maximum number of authors, but we do strongly encourage the inclusion of a statement on the actual contribution of each co-author.

In a lively response to Rose's post, Antoine Blanchard cites strategies developed by high-energy physicists to deal with 'hyperauthorship'. John Quackenbush points to the realities of large-scale interdisciplinary collaborations to achieve something that could not be done alone. "We should stop worrying about who did what and instead ask how the work advances the field. This is science after all, not accounting."

Similarly, Steven Salzberg writes: "The malaria genome paper (M. J. Gardner *et al. Nature* **419,** 498–511; 2002) had nearly 50 authors. That was the culmination of a 6-year effort by an international consortium, and everyone on the author list (including me) spent years on some aspect of the project." ■

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