Abstractions

FIRST AUTHOR
The history of reproductive biology is far from complete, with little evidence available in the fossil record. Last year, placoderms, a group of extinct fishes, were identified as the earliest vertebrates capable of live birth. John Long at Museum Victoria in Melbourne, Australia, and his colleagues reported fossilized embryos in specimens of a small placoderm subgroup found at the Gogo Formation, an exceptionally well-preserved ancient reef community in Western Australia. On page 1124, Long and his co-workers now show that two previously archived specimens of the largest placoderm group also contain embryos. This provides evidence of internal fertilization and may represent the first step of the radical change in vertebrate reproductive biology from egg-laying to live birth. Long tells *Nature* about the sex lives of fossil fish.

After last year's finding did you scour museum archives for embryos?
Yes. We examined Gogo specimens housed at Museum Victoria and at the Natural History Museum in London. We focused on those with reported 'stomach contents', thought to be ingested food. We found no evidence of digestive acids and were stunned to find two specimens containing embryos. This extends the variety of early fossil fishes that we know had live births, and helps us to understand the origins of vertebrate copulation.

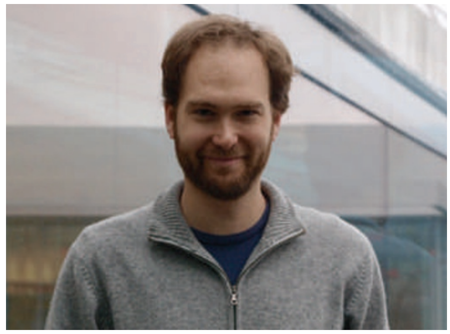
How does the finding shed light on vertebrate reproductive biology?
This group of placoderms, the Arthrodira, lack external genitalia. Without specimens captured during gestation there was no reason to suspect internal fertilization. Once we had evidence in the form of embryos, we re-examined the pelvic girdle in the few intact specimens available and found a pelvic fin and cartilage that articulated towards the tail much like claspers — male sex organs that today's sharks use to copulate.

Of all your discoveries from the Gogo Formation, is this a favourite?
This is a career highlight because it has brought about such a big change in thinking about reproductive strategies throughout evolution. We once thought one of the ancient fish subgroups might have had a quirky form of internal fertilization. Now we think it was widespread across this major group.

Will your work shed light on fish evolution?
We hope the findings will help us to piece together a larger evolutionary puzzle — whether placoderms' closest living relatives are the cartilaginous sharks or bony fishes. Some scientists think placoderms are not related to any current species. ■

MAKING THE PAPER

Leopoldo Petreanu



A light-sensing algal protein eases the mapping of brain circuits.

Much of the brain remains only loosely charted terrain, and one idea for unravelling some of its many mysteries is to map each and every neuron. One region that has received a lot of attention in this regard is the cerebral cortex, which has a key role in processing incoming 'sensory' signals — that is, those from the senses, such as vision and hearing. It is also essential to higher functions like reasoning and planning. Leopoldo Petreanu, a postdoc at the Janelia Farm Research Campus of the Howard Hughes Medical Institute in Ashburn, Virginia, and his colleagues have now found a way to locate the connections, known as synapses, that neurons in other brain regions make onto a group of highly branched cortical cells called pyramidal neurons.

When channelrhodopsin-2 (ChR2) — a light-sensitive ion-channel protein found in green algae — was sequenced in 2003, Petreanu was keen to try it as a new tool with which to map neuronal circuits. He hoped to use light to electrically excite one neuron at a time and then watch others respond. "We expected to be able to get single-cell resolution in a circuit map of the cortex," he says.

He wanted to establish the source of cells stimulating the pyramidal neurons, but he encountered a glitch. When ChR2 is expressed in a neuron, it is spread across the cell surface, and because axons are so intermingled in the brain, even a focused laser would set off more than just the target cell under study. "That was bad news," says Petreanu.

Petreanu and his colleagues realized that, rather than isolating a single neuron, they could instead isolate just the very tips of ChR2-expressing neurons. They turned to an old, reliable constituent of the neuroscience toolbox: tetrodotoxin, a neurotoxin that blocks the propagation of nerve signals from the neuron's cell body down the axon. Now, only functional connections to other neurons would react to light. This is because, even in the absence of nerve signals, the light-activated ChR2 at the very ends of the nerve terminals would still release chemical neurotransmitters, thus activating any neighbouring pyramidal neuron. Using this method, the team was able to identify from which neurons in other brain areas pyramidal neurons receive input.

Petreanu expressed ChR2 in areas of the mouse brain outside the cortex, such as the thalamus, a relay station for incoming sensory signals. He took brain slices and bathed them in tetrodotoxin, then shone a light on them. At the same time, he recorded the activity of the cortical pyramidal neurons. Only those pyramidal cells that came into contact with ChR2-expressing nerve terminals generated a reading (see page 1142).

"We have a technique by which you can rapidly map where the connections are made," says Petreanu. "Before, the only way to see a connection was with electron microscopy."

One surprise was the orderliness of neuronal connections in the cortex. Anatomically, synapses with specific types of input were segregated within certain branches of the pyramidal neurons. How this translates into function is not known, although Petreanu and his co-authors speculate that spatially clustered inputs might rally stronger responses. The next step, says Petreanu, is "to go from this anatomical observation to a functional understanding". ■

FROM THE BLOGOSPHERE

In an increasingly competitive market, journals are working hard to attract customers — not unlike recession-squeezed fancy restaurants — writes Juan Carlos López, editor of *Nature Medicine*, on the Spoonful of Medicine blog (http://blogs.nature.com/nm/spoonful/2009/02/we_want_your_paper.html). López reviews several new policies from journals that are meant to expedite the process of publishing research papers.

The most controversial policy from *Journal of Biology* allows authors to request a paper be published even if not all of the revisions suggested by the reviewers have been addressed. The paper would be flagged as such but, López says, potential reviewers might not be "very keen on lending a hand if [they] won't have a chance to engage in a dialogue with the authors".

Although the appeal to authors of these new models of peer review is obvious, López fears that it will mean "that many scientists may shift into a 'complacent mode'", in which they avoid doing difficult experiments. Even so, he sees the trend for journals to polish up their customer service to be generally more author-friendly as a positive one. ■

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