Abstractions

LAST AUTHOR

It is more than 100 years since Charles Darwin discovered that hybrid plants such as maize (corn) generally grow to be stronger and larger than their parents. The same is true of allopolyploid plants — those formed by hybridizing two or more types of plant, for example wheat and rye. What scientists didn't know was what caused this phenomenon, known as growth vigour. Jeffrey Chen at the University of Texas at Austin and his colleagues discovered that, in both cases, increased growth occurs because many genes for photosynthesis and starch metabolism are more active during the day in such plants. On page 327, Chen and his team explain that these plants' vigour is linked directly to circadian-clock regulators — which control growth, metabolism and fitness. Chen tells *Nature* how clock genes are key to vitality.

Was the study physically demanding?

We had to collect tissue samples every three hours around the clock for several days at a stretch because the expression of genes changes over time according to the circadian clock. One of my co-authors, Zhongfu Ni, a visiting postdoc from China Agricultural University in Beijing, stayed in the lab for three weeks to harvest the samples. He was so exhausted he was almost walking around on his knees.

What were the technical challenges?

Controlling the expression of clock genes is not easy. If these genes are turned off completely, plants and animals lose their fitness and their growth vigour. This can be avoided by lowering the expression of clock genes only during the day. To control the expression of these genes over time, we used a custom-made clock-gene promoter, a DNA fragment that amplifies the expression of a particular gene.

Are these genes the only thing controlling the increased growth of hybrids and allopolyploids?

No. There are certain to be other causes for growth vigour, but these genes are a major factor. We can now consider developing tools to help crops grow better and to increase yield.

Are there any implications for humans?

The circadian clock is a universal mechanism for controlling growth vigour and metabolism in animals as well as plants. In humans, obvious effects of the circadian clock can be seen in jet lag and sleep disorders. If we had a means of resetting the clock, we might be able to overcome these problems. ■

See also Podcast at http://www.nature.com/nature/podcast/index-2008-11-27.html.

MAKING THE PAPER

Martin Brazeau

A. JERVE

'Missing link' in fish fossil record turns out not to be missing at all.

Adorned with spiny fins and diamond-shaped scales, the fossilized 'acanthodian' fishes resemble two of today's fish groups: bony fishes, which include eels and salmon, and cartilaginous fishes such as sharks. Palaeontologists have long puzzled over which family these ancient fishes — which hail from the Devonian period, between around 415 million and 360 million years ago — belong to, because few clues have been gleaned from the limited fossils available. It was thought that the discovery of new fossils might help to set the record straight. Martin Brazeau, a palaeontology graduate student at Uppsala University in Sweden, found that that we have had the answer all long — we just didn't know it.

"Many of these fishes had a cartilagenous skeleton like a shark's and so deteriorated easily," says Brazeau. "I sometimes describe the fossils that we have as 'fish-shaped patches of scales', because we have the scales but no internal skeletal bones. It's hard to compare them to anything else."

In addition to these fossils was a palaeontological prize: the braincase of a fish of the genus *Acanthodes*. This group lived late in acanthodian history, during the Permian period 290 million to 248 million years ago. Many palaeontologists took this fossil to be the representative example of the whole group, and because it has more bony-fish features, ascribed acanthodians to the bony fishes. However, discoveries during the past 15 years of acanthodian fossils with shark-like scales and teeth have called the grouping into question once again.

"These recent fossils started to make us question: are these a natural group or are we looking at a bunch of organisms closely related to the common ancestor of all jawed vertebrates?" says Brazeau. "It's tempting to put them all into one group; however, they might come from different groups but all look very similar." This, Brazeau adds, is a common problem.

While searching the literature at London's Natural History Museum, Brazeau stumbled on a 1973 monograph describing a well-preserved acanthodian called *Ptomacanthus anglicus* from the Welsh border region. The specimen stood out to him. It presented a ventral view of a flattened head that provided a glimpse into the roof of the mouth — a rare opportunity, because most known fossils capture fish side-on. The fossil hailed from the acanthodian heyday of the early Devonian period, and is more than 100 million years older than that of *Acanthodes*. Brazeau checked to see whether the fossil had been further described in the literature. The only references he could find were to its whorled teeth, which, at a superficial level, resemble those of sharks.

Brazeau obtained a rubber cast of the fossil from the museum's collection and found that the brain case was most similar to sharks and placoderms, or bony-headed fish. He then performed a phylogenetic analysis, comparing the characteristics of fossils from 47 groups including bony fish, sharks, acanthodians, placoderms, and jawless fish. According to this, acanthodians as a sole group fell apart. Some members appeared in the bony fish lineage, and others in the shark lineage (see page 305).

Brazeau remarks, "For decades, paleontologists have been holding out for a braincase in addition to *Acanthodes* and there it was sitting in the literature for 30 years." ■

FROM THE BLOGOSPHERE

Does publishing one's thoughts on the web count towards tenure? Probably not, but it has landed six Nature Network bloggers in the 2008 Open Laboratory anthology of best science blog posts (see the winning posts at http://tinyurl.com/7pze3d).

Not surprisingly, four of the six winning posts are woven around issues of how science intersects with the media and how Internet-based new media are changing the ways in which scientists exchange data and ideas.

A blogger going by the pen name Charles Darwin bemoans the media's bias towards macroscience — literally, big science — in the headlines. Jennifer Rohn imaginatively ponders "what the world would be like if science were put under the same media scrutiny as sport". Richard Grant, who can remember the 'days before e-mail', dissects whether scientific collaboration using Web 2.0, or "any kind of WWW-based meeting place" will become as second-nature as e-mail. And Noah Gray argues that mobile-phone camera-snapping actually degrades the usual exchanges meant to take place at poster sessions. ■

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