

# Health | Science

THE BOSTON GLOBE • TUESDAY, MAY 30, 2000

## A little fish challenges a giant of science

By Fred Heeren  
GLOBE CORRESPONDENT

CHENGJIANG, China – The fish-like creature was hardly more than an inch long, but its discovery in the rocks of southern China was a big deal. The 530-million-year-old fossil, dubbed Haikouella, had the barest beginning of a spinal cord, making it the oldest animal ever found whose body shape resembled modern vertebrates.

In the Nature article announcing his latest findings, Jun-Yuan Chen and his colleagues reported dryly that the ancient fish “will add to the debate on the evolutionary transition from invertebrate to vertebrate.”

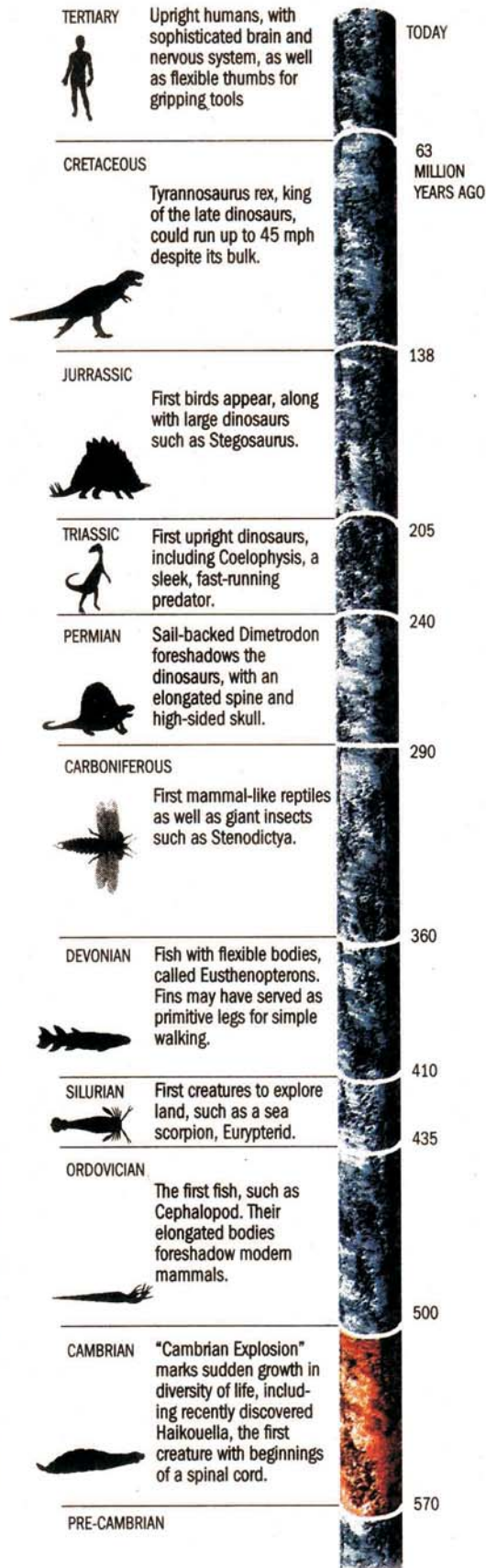
But the new fossils have become nothing less than a challenge to the theory of evolution in the hands of Chen, a professor at the Nanjing Institute of Paleontology and Geology.

FOSSILS, Page E4



PHOTO/FRED HEEREN

Taiwanese biologist Chia-Wei Li examines a fossil near Chengjiang in southern China.



# Fossil of a little fish challenges a giant of science

## FOSSILS

Continued from Page E1

ogy. Chen argued that the emergence of such a sophisticated creature at so early a date shows that modern life forms burst on the scene suddenly, rather than through any gradual process.

According to Chen, the conventional forces of evolution can't account for the speed, the breadth, and one-time nature of "the Cambrian explosion," a geologic moment more than 500 million years ago when virtually all the major animal groups first appear in the fossil record.

Rather than Charles Darwin's familiar notion of survival of the fittest, Chen said he believes scientists should focus on the possibility that a unique harmony between forms of life allowed complex organisms to emerge. If all we have to depend upon is chance and competition, the conventional forces of evolution, Chen said, "then complex, highly evolved life, such as the human, has no reason to appear."

The debate over Haikouella casts Western scientists in the unlikely role of defending themselves against charges of ideological blindness from scientists in Communist China. Chinese officials argue that the theory of evolution is so politically charged in the West that researchers are reluctant to admit shortcomings for fear of giving comfort to those who believe in a biblical creation.

"Evolution is facing an extremely harsh challenge," declared the Communist Party's Guang Ming Daily last December in describing the fossils in southern China. "In the beginning, Darwinian evolution was a scientific theory. . . . In fact, evolution eventually changed into a religion."

Taunts from the Communist Party wouldn't carry much sting, however, if some Western scientists weren't also concerned about weaknesses in so-called neo-Darwinism, the dominant view of evolution over the last 50 years.

"Neo-Darwinism is dead," said

Eric Davidson, a geneticist and textbook writer at the California Institute of Technology. He joined a recent gathering of 60 scientists from around the world near Chengjiang, where Chen had found his first impressions of Haikouella five years ago.

But most Westerners at Chen's conference came to praise Darwin, not to bury him. The idea that neo-Darwinism is missing something fundamental about evolution is as scandalous to Americans as it is basic to the Chinese.

Despite their misgivings about Chen's "harmony" proposal — a mysterious mix of scientific caution, Chinese philosophy, and a decidedly non-Western lack of concern for Darwinian orthodoxy — Western scientists have no choice but to go to China to learn about the emergence of animal body plans, including that of humans.

Virtually all of today's living phyla — or major animal groups — make their first impressions in the geologic period known as the Cambrian. And Chengjiang, in the southern province of Yunnan, contains the oldest and best preserved Cambrian fossils in the world. Jun-Yuan Chen has co-authored half of all the papers on the Chengjiang fauna.

Chen's discovery of the earliest creature with a primitive nervous system, called a chordate, is, for him, but one more piece in a puzzle that looks less and less like the conventional picture of evolution through natural selection.

For Western paleontologists, Haikouella looks like a breakthrough for understanding the origin of the human lineage.

"It proves that the direct ancestor of mankind already existed in the time of the Cambrian explosion," said German paleontologist Michael Steiner.

"Sort of instinctively, I felt I should go and pay homage to this animal," said another scientist at the conference, Nicholas Holland, an authority on primitive chordates at the Scripps Institution of Oceanography in San Diego. "It's the ear-



GLOBE PHOTO / FRED HEEREN

**Taiwanese biologist Chia-Wei Li has been working with paleontologist Jun-Yuan Chen at the site of the Haikouella fossil discovery.**

liest known chordate ancestor. This is going to be page one, two, three and four of vertebrate texts."

Chen enjoys seeing his fossils get the attention. But to him, the big story is not that he has discovered our earliest traceable ancestor but that the Cambrian explosion of new body plans is proving to be real, not an illusion produced by an incomplete fossil record.

Because new animal groups did not continue to appear after the Cambrian explosion 530 million years ago, he believes that a unique kind of evolution was going on in Cambrian seas. And, because his years of examining rocks from before the Cambrian period has not turned up viable ancestors for the Cambrian animal groups, he concludes that their evolution must have happened quickly, within a mere 2 or 3 million years.

According to Chen, the two main forces of evolution espoused by neo-Darwinism, natural selection ("survival of the fittest") and random genetic mutation, cannot account for the sudden emergence of so many new genetic forms.

"Harmony can be a driving force [of evolution], too," Chen proposed at the Chengjiang conference.

As if to underscore the abruptness of Haikouella's place in the

fossil record, Chen pointed out the features that make Haikouella look so much more advanced than expected for an early Cambrian animal.

Biologists had been expecting to see something that would look like a primitive ancestor to the middle Cambrian animal called Pikaia, formerly promoted as the world's earliest chordate. Rather than finding evidence that Pikaia had a less-complex ancestor, Chen instead found a chordate that already displayed many vertebrate characteristics 15 million years earlier.

And some of the 305 fossil specimens Chen's team has recovered are so well preserved that paleontologists practically swoon over them.

"They're almost like a photograph of the anatomy of the animals," said French paleontologist Philippe Janvier.

But all this newfound clarity only adds to the larger problem, framed succinctly by Holland of Scripps Institution: "Where the hell are you going to get an animal like that?" In his view, Haikouella's high level of development makes it more difficult to explain the evolutionary steps that produced it.

The place to find earlier steps, of course, should be the Precambrian rocks that are more than 543

million years old. Darwin wrote that, if his theory is true, then the world must have been swarming with the ancestors of the Cambrian critters during long ages before them. He expected future generations to find them.

Today, paleontologists still lack viable ancestors for the Cambrian's 40 or more animal phyla. Most researchers explain this by assuming that Precambrian animals were simply too small or too soft to leave a fossil record, or that conditions were unfavorable to fossilization.

But, for the last three years, Chen's discoveries at Precambrian fossil sites with Taiwanese biologist Chia-Wei Li have magnified this mystery. While sifting through the debris of a phosphate mining site, Chen and Li eventually discovered the earliest clear fossils of multicellular animals. They found sponges and tiny sponge embryos by the thousands — but nothing resembling the fish-like Haikouella or forerunners of other Cambrian creatures, such as trilobites.

When word of the discovery got out, Chen and Li suddenly found themselves in the international spotlight. But when the hoopla was over and their discovery established, they wondered what evolutionary problems they had actually solved.

In fact, the pair had failed to find any recognizable body plans showing steps along the way toward the complex Cambrian animals, with their legs, antennae, eyes and other features.

What they had actually proved was that phosphate is fully capable of preserving whatever animals may have lived there in Precambrian times. Because they found sponges and sponge embryos in abundance, researchers are no longer so confident that Precambrian animals were too soft or too small to be preserved.

"I think this is a major mystery in paleontology," Chen said. "Before the Cambrian, we should see a number of steps — differentiation of cells, differentiation of tissue, of dorsal and ventral, right and left.

But we don't have strong evidence for any of these."

Taiwanese biologist Li was also direct: "No evolution theory can explain these kinds of phenomena."

In Chen's view, his evidence supports a history of life that runs opposite to the standard evolutionary tree diagrams, a progression he calls top-down evolution.

In the most published diagram in the history of evolutionary biology, Darwin illustrated what became the standard view of how new taxa, or animal categories, evolve. Beginning with small variations, evolving animals diverge farther from the original ancestor, eventually becoming new species, then new genera, new families, and the divergence continues until the highest taxa are reached, which are separated from one another by the greatest differences.

But the fossil record shows that story is not true, according to Chen. The differences appear dramatically in the early days, instead of coming at the top. Chen suggested that biologists need to seek new mechanisms to explain these evolutionary leaps.

Wherever the first chordates came from, Nicholas Holland of Scripps agreed that science should now take seriously the possibility that evolution can occur in relatively quick jumps.

That still leaves a great divide between Chen, Li and the Chinese media on one side and the mainstream Western view, in which scientists are reluctant to admit that the Cambrian explosion poses a difficult challenge.

But conferences such as the one in Chengjiang may be changing some views. One of the symposium organizers, paleontologist David Botter of the University of Southern California in Los Angeles, said he disagrees with the idea of rapid evolution, but he conceded, "The Cambrian Explosion is going to tell us something different about evolution, in the sense that it's not the same story that we have always been taught."