

Starlight spotlights galaxy's slow start

A study of starlight from two of the Milky Way's oldest structures strongly supports the notion that our galaxy took three times longer to evolve than estimated by a widely accepted theoretical model.

During the past decade or so, several researchers have speculated that the young Milky Way may have taken as long as 3 billion years to collapse from a spherical cloud of gas into its present disk shape. This contrasts with a standard theory proposed in 1962, which calculates the collapse time at 1 billion years.

The researchers based their revised timetable on differences in the color and brightness of stars, including some residing in globular clusters—ancient, densely packed stellar regions that surround both the central bulge and periphery of the Milky Way (SN: 4/6/91, p.218). In particular, several teams of astronomers in 1989 and 1990 asserted that differences in the properties of stars from two globular clusters, NGC 288 and NGC 362, could best be explained if the clusters were separated in age by 3 billion years. Since globular clusters rank among the first objects formed in the Milky Way, the proposed age span would require the galaxy to take at least that long to evolve from a gaseous sphere to a disk.

Critics countered that this evolutionary scenario left open a major loophole. The observed differences in stellar color and brightness, they argued, might instead result from a variation in chemical composition among stars in the two clusters. If the two clusters had the same age

but different compositions, then the standard theory of formation would still hold for the Milky Way.

An international research team has now gathered data that appear to close the loophole. Roger A. Bell of the University of Maryland in College Park and his colleagues used a high-resolution spectrograph to analyze the visible light emanating from the surfaces of a total of 15 red giant stars in the two clusters. In the May 16 NATURE, they report that NGC 288 and NGC 362 have nearly identical chemical compositions, supporting claims that the clusters indeed differ in age by 3 billion years.

Bell notes that astronomers previously estimated that both clusters had a relatively low ratio of iron to hydrogen. But his team's spectroscopic study, conducted at the Anglo-Australian Telescope in Siding Springs, Australia, used a different strategy to determine and compare chemical composition. For the first time, the researchers measured the abundances of three key elements—carbon, nitrogen and oxygen—relative to the abundance of hydrogen.

As a stellar core burns hydrogen, nuclear reactions convert one element to another, changing their relative abundances in the star's interior, Bell explains. Eventually, the modified composition may alter the elements' relative abundances on the surface of the star, masking the star's original chemical make-up, he says. This makes it difficult to determine whether one star really began with a composition similar to another.

But a star's *total* abundance of all three elements remains constant and thus provides a more reliable guide for comparison, Bell says. When he and his collaborators added up the abundances of carbon, nitrogen and oxygen for each of six stars from NGC 288 and nine from NGC 362, they found nearly equal total abundances among all the stars—clinching the argument that the two globular clusters have a similar chemical make-up.

"The significance of this paper is that it shows chemical composition is not involved [in the observational differences between stars in the two clusters]," comments Leonard Searle of the Carnegie Institution of Washington in Pasadena, Calif. "That certainly increases the presumption that age is what *is* involved."

Searle, who first suggested in 1978 that our galaxy took 3 billion years to evolve into a disk, speculates that a longer-than-expected time interval for the Milky Way's evolution indicates that it may have formed from the merger of two galaxies.

Bell says his group plans to confirm and expand the new results by analyzing the chemical composition of stars in other Milky Way globular clusters.

— R. Cowen

Enigmas overturned by Chinese fossils

With the help of a new fossil discovered in China, paleontologists are starting to make sense out of some of the most problematic and bizarre animals known in Earth's history. Several of these strangers from 530 million years ago—previously viewed as failed evolutionary experiments, with no counterparts in the modern world—now appear to fit into an existing animal phylum.

The newly found caterpillar-like animal is among the latest prizes to emerge from an extraordinary set of fossil beds in the Chengjiang area of southwestern China. The dozens of species discovered so far within these rich formations are painting a picture of life in the early Cambrian period, which began just after the evolutionary "big bang" that gave birth to almost all the major groups of modern multicellular animals.

For decades, paleontologists have labored to understand the Cambrian's oddball creatures, which don't fit readily into existing animal phyla. Using the new, as-yet-unnamed Chinese fossil as a guidepost, two researchers now suggest that some of the most enigmatic of these animals belong to the phylum Onychophora, which in the modern world includes the velvet worms of the tropics. Lars Ramsköld of the Swedish Museum of Natural History in Stockholm and Hou Xian-guang of the Nanjing Institute of Geology and Paleontology in China describe their findings and conclusions in

Rice: Methane risk rises

Climate change analysts have estimated that rice paddies contribute about 14 percent of the methane—a major greenhouse gas—emitted into the atmosphere by human activities each year. But that calculation, based largely on Western data, may substantially underestimate the global warming threat posed by rice cultivation.

A new study suggests that Chinese fields—which produce about 185 million tons of rice annually, or 36 percent of the world's total—may generate four to 10 times more methane than U.S. or European fields.

Scientists from the Oregon Graduate Center in Beaverton and Academia Sinica's Institute of Atmospheric Physics in Beijing, China, collaborated on a two-year study of methane emissions from rice paddies in TuZu, a rural village in the heart of the Sczuan province. Alternating between morning and afternoon sampling periods, the researchers measured methane emissions from six sites in four separate fields every other

day throughout two 120-day growing seasons. The roughly 13,000 separate readings indicate that the TuZu paddies emit roughly 60 milligrams of methane per square meter each hour.

This overall methane emission rate is five times higher than that of U.S. rice fields, 3.75 to 8.5 times higher than Italian fields and 15 times higher than Spanish fields, report M.A.K. Khalil and his coauthors in the May ENVIRONMENTAL SCIENCE & TECHNOLOGY. The researchers note, however, that methane fluxes vary considerably throughout the growing season. The TuZu fields emitted about 15 percent more methane in the afternoon than during the morning, for instance, and their offgassing rate tended to increase as the growing season progressed. The rates plummeted once the plants reached maturity and outdoor temperatures fell.

As the collaborators continue their studies, they hope to tease out the extent to which climate, soil conditions, fertilizer type and rice variety affect a paddy's methane releases. □

the May 16 NATURE.

The newly discovered animal “makes the Cambrian bestiary look a lot less bizarre than it used to,” says Stefan Bengtson, a specialist in Cambrian fossils at Uppsala University in Sweden.

The keystone fossil has a segmented body stretching 5 to 6 centimeters in length, with 11 pairs of balloonish legs that end in two-pronged claws. Onychophorans share these same features, leading Ramsköld and Hou to group the new fossil with the existing phylum. In the modern world, onychophorans live on land, mainly in the moist litter of tropical forests. Bengtson describes them as looking like a cross between a centipede and the Michelin Man.

To make the onychophoran connection, Ramsköld and Hou have stretched the boundaries of the phylum. The Cambrian animal, unlike the modern forms, lived in the ocean and sported 10 sets of rigid back plates, each topped by a pointy spine.

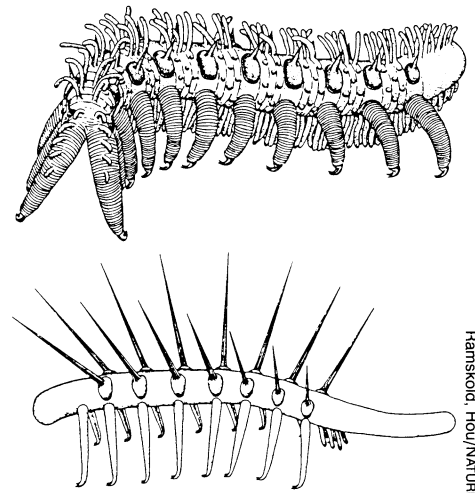
The two researchers have used the new fossil as a stepping stone to categorize some of the most puzzling Cambrian fossils found in Canada's Burgess Shale formation and other sites around the world. One of the weirdest, appropriately named *Hallucigenia*, looks like something out of a Dr. Seuss book. Previous restora-

tions have depicted this inch-long animal walking on seven pairs of spiky legs, with a row of seven tentacles sprouting from its back—a beast so bizarre that it defies categorization.

But Ramsköld and Hou think the standard reconstruction of *Hallucigenia* has got the animal turned upside down. They suggest that the tentacles are actually legs, and the spikes stick up from the back of the creature, like longer versions of the spines seen on the new Chinese fossil. The connection between *Hallucigenia* and the unnamed Chengjiang animal has led the two researchers to draw *Hallucigenia*, as well as some other Cambrian oddities, into the fold of Onychophora.

Although this work has attracted the attention of other Cambrian experts, most paleontologists remain unconvinced by Ramsköld and Hou's interpretation of *Hallucigenia*. Their biggest hurdle is a missing set of legs. Only two good *Hallucigenia* fossils have been found so far, and each shows only one row of the “tentacles” that Ramsköld and Hou have labeled legs. The two researchers believe another set lies buried beneath the visible legs.

“I think they're probably right. It may well be that the animal is the other way up,” says paleontologist Simon Conway



Newly discovered Cambrian fossil (top) and revised view of *Hallucigenia*.

Ramsköld, Hou/NATURE

Morris of the University of Cambridge in England. If so, the reversal will overturn Conway Morris' own interpretation of *Hallucigenia*, which he proposed in the late 1970s.

This week, Conway Morris and Ramsköld visited the Smithsonian Institution in Washington, D.C., and examined the two *Hallucigenia* specimens housed there, in hopes of resolving the issue.

— R. Monastersky

AIDS dementia: Neurons nixed by virus?

Almost one-third of all AIDS patients eventually develop encephalitis, or inflammation of the brain. As their encephalitis progresses, memory loss and other forms of dementia become increasingly severe. This has led scientists to suspect that AIDS dementia arises because the inflammation damages brain cells.

Now, evidence from an autopsy study suggests a more direct mechanism for these debilitating changes: The AIDS virus itself may destroy neurons in the frontal cortex of the brain.

Laboratory studies in recent years have shown that the AIDS virus, HIV, somehow manages to kill neurons in culture, even though it does not enter and infect them. Those findings spurred three British neuropathologists to determine whether the virus can, in the absence of encephalitis, inflict enough neuronal damage to cause dementia in people with AIDS. Ian P. Everall and his colleagues at the Denmark Hill Institute of Psychiatry in London tested their hypothesis by examining the frontal cortex, an area involved in thought and reasoning, of 11 deceased AIDS patients and eight people who died of causes unrelated to AIDS or encephalitis.

The investigators used a newly developed tool called a dissector to calculate

the density of neurons in three-dimensional sections of the frontal cortex samples. The neuron density in the AIDS patients' brains was almost 40 percent lower than in the non-AIDS brains, they found.

Although fluid from all of the AIDS brains harbored HIV, six of the 11 showed no signs of encephalitis. Moreover, the researchers discovered that the neuron density in those six brains was just as low as in the five encephalitic AIDS brains. This, they say, suggests that HIV alone can cause a loss of neurons.

Because Everall and his co-workers did not have access to the patients' clinical records, they do not know whether any of them actually had dementia. Nonetheless, they assert in the May 11 LANCET, “the cause of dementia in AIDS patients has to be reevaluated.”

“This is the first investigation that has shown neuronal loss without HIV encephalitis,” says coauthor Peter L. Lantos. Finding such a dramatic loss in a cortical area of the brain is especially significant, Everall adds, because a comparable degree of cortical cell loss is associated with the severe dementia suffered by Alzheimer's patients.

“These types of losses are going to have a physiological impact,” says Clayton A. Wiley, a pathologist at the Univer-

sity of California, San Diego.

Because the new study does not establish any clinical connection with dementia in encephalitis-free AIDS patients, Everall cautions that the findings do not prove that HIV causes dementia by killing neurons. He does, however, propose what he calls “a sensible and logical mechanism” by which the virus might kill cortical neurons directly. An HIV envelope protein called gp120 may interfere with a brain peptide called VIP that some cortical neurons need in order to send electrical signals to one another, he told SCIENCE NEWS. Researchers already know that this peptide can, in the test tube, protect brain neurons from the toxic effects of gp120, he adds.

Brynmor A. Watkins of the National Cancer Institute in Bethesda, Md., questions the British team's exclusive focus on the frontal cortex, which may have led them to overlook encephalitis in other brain parts, especially lower regions such as the basal ganglia and the cerebellum. Encephalitis in these subcortical regions correlates strongly with certain symptoms of AIDS dementia, such as limb weakness and poor coordination, he says. In addition, he argues that the six seemingly encephalitis-free AIDS patients may have had frontal-cortex inflammation at one time and that their encephalitis subsided before they died.

— T. Walker