among other things, whether the virus is as nonpathogenic as it currently appears.

How the AIDS Virus May Hide in Macrophages

One of the major puzzles about the AIDS virus concerns the way in which it manages to hide in the body, often escaping destruction by the immune system for many years before it causes disease. Howard Gendelman of the Walter Reed Army Institute of Research in Washington, D.C., presented data that may help explain how it does this.

Within the past year or so, the immune cells known as macrophages or monocytes have come to the forefront as the likely first cell type to be infected by the AIDS virus and also the probable reservoir of the virus in the body. Recently, Gendelman and his colleagues have learned how to maintain macrophages in culture for long periods.

While using these cultures to isolate HIV-1 from AIDS patients, they noted a paradox. Although 60 to 90% of the cultured macrophages that became infected with the AIDS virus make viral messenger RNAs, which indicates that the virus replicates in the cells, little virus was present in the culture fluids.

Electron microscopic studies then revealed, Gendelman says, that "the virus was budding and accumulating into cytoplasmic vacuoles instead of budding from the cell surface." In particular, the virus was accumulating in vacuoles associated with the Golgi apparatus, an internal system of membranous disks in which many cell proteins mature and are sorted for transport to their final destinations in or out of the cell. The low virus concentrations in the culture fluid suggests that the macrophages secrete some of the virus particles to the exterior, although most apparently remain inside.

The presence of the particles in the cytoplasmic vacuoles does not appear to have adverse effects on the macrophages. "At least morphologically and by simple criteria they look normal," Gendelman remarks. The Walter Reed workers have also found that macrophages in brain tissue from an AIDS patient contain internal accumulations of virus particles.

What these observations might mean for escape of the AIDS virus from immune surveillance and progression of the disease is not yet clear, Gendelman cautions. They nonetheless suggest that the sequestering of HIV-1 particles inside macrophages, where they are presumably safe from immune attack, allows the cells to serve as "Trojan horses" for maintaining and transmitting the AIDS virus in the body. ■ JEAN L. MARX

Bringing Chinese Dragons to the Western World

A big exhibit of Chinese fossils has early mammaliaforms, death assemblages, and film star Michael Douglas explaining cladistics

New York City

THE LARGEST EXHIBITION of Chinese fossil bones ever displayed in the West represents the reawakening of paleontology in the People's Republic of China, as well as providing a reminder of its troubled past. "The Chinese are proving to us that not only can they unearth all these weird-looking creatures, but they can make sense of them, too," says Eugene Gaffney of the American Museum of Natural History in New York, which is putting on the show with colleagues from the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing.

"From the Land of Dragons" displays 42 specimens from China, which offer a glimpse of the richness of the ancient vertebrate presence in Asia and a hint of what is still left to uncover. Discoveries made in China in recent years, which include dinosaurs and early relatives of mammals, rival specimens collected in North America at the turn of the century, when many of the first complete fossils were excavated and many of the shelves in the American Museum were filled.

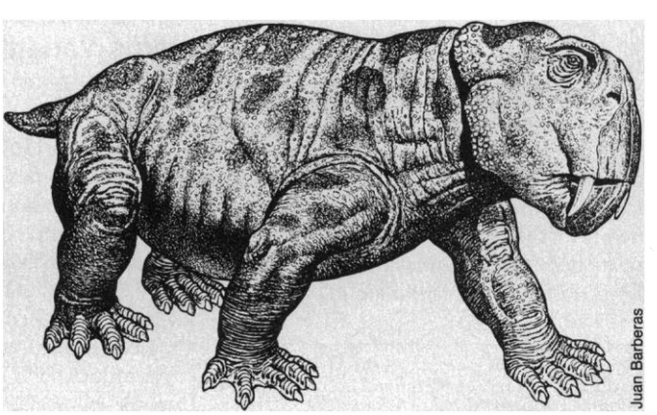
Says James Hopson of the University of Chicago: "The Chinese are finding some terrific stuff." Hopson says that China is exciting to paleontologists because, like North America, it possesses a very diverse and complex geology in which rock from many time periods is exposed.

The exhibition of old bones is remarkable not only for the presence of the Chinese fossils, but because the exhibit takes some risks. It is perhaps the first in this country to try to give museum visitors a real sense of how modern paleontologists use a system called "cladistics" to classify relationships among animals by comparing primitive or derived "characters"—be the characters backbones, jaw hinges, hip sockets, or holes in the head. For example, dinosaurs and birds are more closely related than horses and birds because dinosaurs and birds share a unique kind of hip bone.

Says Gaffney: "The real excitement of paleontology is putting together the puzzle. We wanted to show people that science can make some kind of sense of all these bones we dig up."

These are surely noble goals, but whether loyal patrons of the American Museum, which include armies of screaming, dinosaur-crazed school children, will understand what cladistics and "groups within groups" is all about is uncertain. At times, the going can get rough. But Gaffney and exhibit coordinator Lowell Dingus and designer Willard Whitson certainly give it the old college try. To liven up the show, they even managed to rope film actor Michael Douglas into the project. Accompanied by music from a Mongolian yurt hut, Douglas narrates a snappy 10-minute video, which plays over and over in a corner of the exhibition hall and explains the tenets of cladism and attempts to place the Chinese fossils in an evolutionary context.

Upon entering the hall, the visitor is greeted by a blinking diagram that resembles a family tree but is actually a thinly disguised "cladogram" that asks: "Why



Lystrosaurus. *Early relatives of mammals, dicynodonts roamed the supercontinent Pangaea for 60 million years before the dinosaurs took over. The two tusks were the only teeth in their head. They also had a beak.*

aren't you a dinosaur?"

The exhibit, and the cladogram, are split into two distinct groups. On the one branch are the synapsids, which include the mammals and their earliest relatives, the vegetarian dicynodonts and carnivorous cynodonts. On the other branch are the sauropsids, which include groups such as turtles, lizards, snakes, crocodiles, and birds, as well as the ever popular dinosaurs and flying pterosaurs.

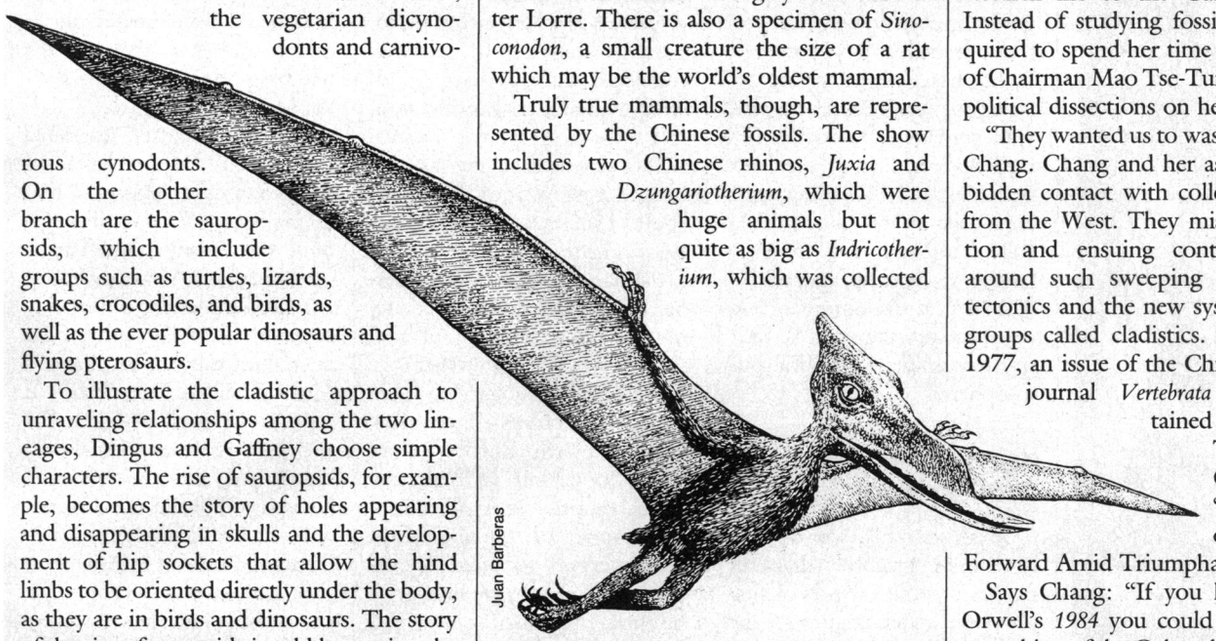
To illustrate the cladistic approach to unraveling relationships among the two lineages, Dingus and Gaffney choose simple characters. The rise of sauropsids, for example, becomes the story of holes appearing and disappearing in skulls and the development of hip sockets that allow the hind limbs to be oriented directly under the body, as they are in birds and dinosaurs. The story of the rise of synapsids is told by tracing the evolution of the mammalian jaw, which grows increasingly sophisticated in its ability to nip, shear, grind, and chew as the animals evolve across the cladogram.

The mammalian tale begins with the dicynodonts, a large and diverse group of very early mammal relatives which ranged in size from rats to rhinos and possessed two tusks and a turtlelike beak. Some dicynodonts may have been involved in head-butting, says Timothy Rowe of the University of Texas, though the jury is still out on the question. (One thing Gaffney says he wishes he could have gotten into the exhibit is a sense of how controversial the field can be: "People come to museums to learn the right answers, but science is often just waiting to be proved wrong," says Gaffney.)

The exhibit is particularly well represented by the short and stout dicynodonts. For the first time, dicynodont skulls from every continent are on display, a distribution that suggests to visitors that 200 million years ago the continents were joined together in the supercontinent Pangaea. There is also a remarkable 13-ton slab uncovered in 1962 in the Xinjiang Province. Called "The Nine Dragon Wall," the slab records a death assemblage of juvenile dicynodonts. Whether dicynodonts were gregarious is not known. They might have moved in herds, though there are no fossil traces of parallel tracks.

In addition to dicynodonts, the exhibit shows other early relatives of mammals called mammaliamorphs and mammaliaforms, including representatives of the group tritylodonts, an early rodentlike relative of mammals that possessed large incisors and complex cheek teeth that make the sketch of the animal strangely resemble Peter Lorre. There is also a specimen of *Sinoconodon*, a small creature the size of a rat which may be the world's oldest mammal.

Truly true mammals, though, are represented by the Chinese fossils. The show includes two Chinese rhinos, *Juxia* and *Dzungariotherium*, which were huge animals but not quite as big as *Indricotherium*, which was collected by the American Museum of Natural History during its first expedition to Mongolia in 1922. Based on the size of its skull, *Indricotherium* is the largest known land mammal: 16 feet high, 24 feet long, and weighing over 30 tons.



Juan Barberas

Dsungaripterus. *A 135-million-year-old Chinese pterosaur with wingspan of 11 feet.*

On the other side of the cladogram, fine specimens of sauropsids are also included. Since Gaffney works with turtles, there are plenty of those. The Chinese archosauriform, *Chasmatosaurus*, which resembles modern crocodiles in body plan, but lacks many of the advanced skeletal features of modern crocodiles, is featured. One of the most enigmatic specimens is a nearly complete skeleton of another archosauriform called *L otosaurus*. "Instead of teeth, the thing's got a horny bill and it's also got these long spines along the vertebrae," says Gaffney. Nobody knows what *Lotosaurus* did for a living.

A flying pterosaur from China called *Dsungaripterus* is shown and several dinosaurs, including a Chinese relative of brontosaurus called *Datosaurus*.

Gaffney believes that the exhibit of these Asian bones quietly demonstrates the "reawakening" of paleontology in China, which has survived great upheavals in the last 50 years, with the invasion of the Japanese in 1937 followed by the Cultural Revolution in 1966.

In many ways, the life of Mee-Mann Chang, the current director of the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing, tells the story of the most recent "interruption." Chang, an expert in primitive fish, lost 10 years of her research life to the Cultural Revolution. Instead of studying fossils, Chang was required to spend her time reading the words of Chairman Mao Tse-Tung and performing political dissections on herself.

"They wanted us to wash our brains," says Chang. Chang and her associates were forbidden contact with colleagues or journals from the West. They missed the introduction and ensuing controversies swirling around such sweeping concepts as plate tectonics and the new system for arranging groups called cladistics. Indeed, as late as 1977, an issue of the Chinese paleontology journal *Vertebrata PalAsiatica* contained an article by the Theoretical Study Group entitled "Sweep out Gang of Four March Forward Amid Triumphant Songs."

Says Chang: "If you have read George Orwell's *1984* you could begin to imagine something of the Cultural Revolution, but it was still much worse."

Chang was forced to spend 2 years in the countryside doing hard labor in a cotton field that had previously been reserved for criminals. After Mao died in 1976, and things began to settle down in China, Chang eventually was allowed to return to the Swedish Natural History Museum in Stockholm, where she picked up the same specimen she had set aside in 1967 upon her return to China. "When I walked alone in the big hall of the museum I felt like I was in a dream because I never thought I would be able to return," says Chang.

Says Gaffney: "It's amazing, really, that the Chinese have come so far in the last few years." The paleontology institute in Beijing is crammed with over 120,000 specimens and some 100 researchers. Field excavations and joint ventures with scientists from Canada, West Germany, and the American Museum of Natural History are being pursued. The Chinese host about 100 scientific visitors a year. Recently, the Chinese Academy of Sciences gave permission to build a museum to display the institute's holdings, though the government has agreed to pay for only half of the museum's $4-million price tag. The rest must come from international foundations. With her earnings from the New York exhibit, Chang will buy a computer and some books. Next year, the exhibit will travel to the Boston Museum of Science and then to the Natural History Museum of Los Angeles County.

■ **WILLIAM BOOTH**