costimulatory molecule. To the Nadler group's delight, their fishing expedition was a success. In work described on page 909, they caught the cDNA for B7-2, which is 26% identical to B7-1. They then genetically engineered B7-2 into cells that do not normally send a costimulatory signal to show that it could perform that function.

The Boston group wasn't the only one hot on the B7-2 trail. Over at the National Institutes of Health, Richard Hodes and his colleagues were making monoclonal antibodies to activated mouse B cells, one type of cell that can present antigen to T cells. Sifting through these monoclonals, they found one that blocked T-cell activation, but did not bind B7-1. They then used this antibody to immunoprecipitate and characterize murine B7-2 (see p. 905).

The two groups now had evidence that B7-2, as well as B7-1, can costimulate T cells. But they couldn't tell which of the two molecules really was the star and which was the supporting actor. So the Nadler group looked at the times when B7-1 and B7-2 appeared on an active APC's surface. B7-1 didn't pop up until 24 to 48 hours after an APC sent its first signal to a T cell. This seemed too long, because many studies have shown that unless a T cell receives the costimulatory signal within 24 hours of the first, it will breed a population of cells that cannot respond to the specific antigen. In contrast, they found that messenger RNA for B7-2 was present in unstimulated APCs, suggesting that B7-2 could appear almost immediately after receiving the first signal. The researchers concluded from this that B7-2 deserved top billing as the molecule that sends the primary costimulatory signal.

Still more proof of B7-2's drawing power is reported in this week's *Nature*. Lewis Lanier's lab at Palo Alto's DNAX Research Institute has cloned a human B7-2 (called B-70). Lanier says his molecule is expressed all the time on the APCs called monocytes, indicating that it can provide a signal immediately.

The discovery of B7-2 could ultimately have important clinical implications. One possibility is that, as with CTLA4-Ig, antibodies to B7-2 might suppress transplant rejection by teaching cells to ignore foreign tissues that they would otherwise savage (*Science*, 7 August 1992, p. 751). Cancer is another target—because tumor cells often lack B7-1, perhaps creating a state that allows them to dodge immune attack. Mouse experiments have shown that tumor cells engineered to make B7-1 can potently stimulate anti-tumor immunity (*Science* , 15 January, p. 310 and 368). B7-2 might trigger an even stronger response. But right now, the only certainty is this: The B7 drama will continue to surprise.

–Jon Cohen

MEETING BRIEFS

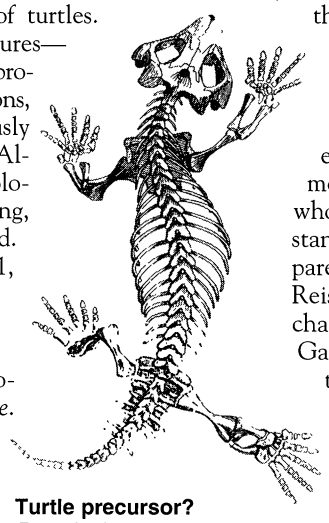
Paleontologists Examine Old Bones and New Interpretations

The 53rd annual meeting of the Society of Vertebrate Paleontology took place in Albuquerque, New Mexico, from 13 to 16 October. As always in paleontology, many of the talks related to family matters—among them the search for the ancestors of living animals, and how to tell whether a *T. Rex* is a boy or a girl.

Turning Turtle

For most of this century, turtles have been paleontological orphans, the only living higher vertebrates whose lineage couldn't be traced all the way back to the earliest reptiles. Recently, however, turtles, like the winner of a lottery, have begun to find they have many relatives. In the past 3 years, two researchers have come up with two different groups of 250-million-year-old animals as candidates for the ancestors of turtles. Each group of four-legged creatures—one called pareiasaurs, the other procolophonids—has its champions, and the debate had previously seemed deadlocked. But at the Albuquerque meeting the procolophonids appeared to be crawling, slowly but steadily, into the lead.

The debate began in 1991, when Robert Reisz and Michel Laurin, paleontologists at the University of Toronto, presented a case for the procolophonid connection in *Nature*. Michael Lee of the University of Cambridge presented the other side 2 months ago in the 24 September *Science*. The skeletal characteristics Reisz interpreted as exclusive to turtles and procolophonids, Lee argued, were actually widely shared among early reptiles. As a result, they can't be used to draw an especially close connection between any two groups. Lee identified 25 other features of turtles' skull, palate, and forelimbs and digits—among other parts of the anatomy—that, he said, resemble features found in pareiasaurs more than they resemble features of other early reptile groups. He also contended that the bony plates, called osteoderms, that sheathed pareiasaurs were the precursors of the armored shell seen even in the earliest turtles, which appeared 200 million years ago.



Turtle precursor? *Procolophon*, a 250-million year-old animal, may be the closest thing to a turtle.

In Albuquerque, however, Reisz gave his case an even harder shell. Based on new examinations of procolophonid and pareiasaur specimens from Russia and South Africa, as well as other types of ancient reptiles, he listed a suite of other features that link turtles and procolophonids, including elements of the shoulder and upper limb bones, the shape of the stapes (a bone in the middle ear), as well as the shape of the lower jaw and its attachment point to the skull.

Many other paleontologists at the meeting found his ideas convincing. "Reisz's arguments are more sophisticated and better tested," says turtle expert Eugene Gaffney of the American Museum of Natural History. But these family disputes, ultimately resting on judgment calls about resemblances in skeletons, always have an element of subjectivity, and Lee, who wasn't at the meeting, stands by his 25 links between pareiasaurs and turtles. He says Reisz must "ferret out a lot more characters" to carry the day. But Gaffney thinks Reisz's characters are more specific and less open to variable interpretation than many of those used by Lee. "Some of Lee's characters are things like 'the basicranium [bottom of the skull] is thick.' What do you do with that?" he asks. In addition, paleontologist Kraig Derstler of the University of New Orleans points out that the dermal armor Lee cites looks quite different from turtle shells.

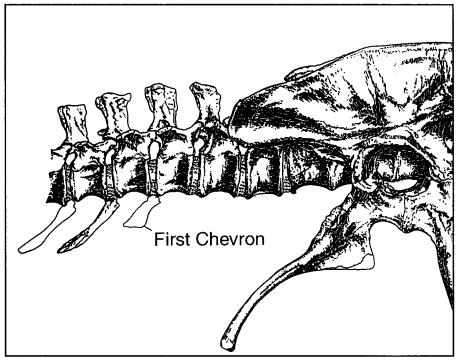
One important point of agreement in this dispute is that both ancestor candidates belong to an obscure group called "parareptiles." Previously thought to have died out 200 million years ago, their turtle relatives are now seen to be still crawling the earth.

Out of the Cold

In recent years, the Arctic has been a rich hunting ground for dinosaur fossils. Now the action is shifting to the south as the Antarctic gets a turn. At the meeting, paleontolo-

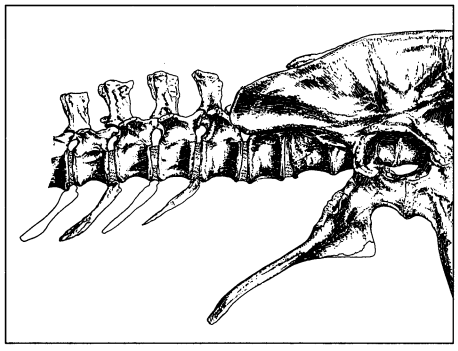
gists announced that 2 tons of rock excavated near the Beardmore glacier, just 650 kilometers from the South Pole, have yielded bones from several species. Among them: a previously unknown carnivorous dinosaur that lived between 200 and 175 million years ago—at least 20 million years earlier than any other large carnivores known so far.

William Hammer and William Hickerson of Augustana College in Rock Island, Illinois, found the fossil-bearing rock in 1991, but it took 2 years for them to chip through enough surrounding stone to get a good look at the bones. When they did, they found partial fossils from small scavenging dinosaurs, the humerus from a pterosaur (a winged dinosaur), as well as something truly remarkable: a 60-centimeter-long skull with a forward-facing bony crest on top. The skull looks a little like that of allosaurus (a theropod, or bipedal carnivore, that lived much later). But the crest is distinctive: Other crests on theropods face to the side, but this one faces forward. "It spreads out like a peacock's feathers," Hammer says. Paleontologists assume such crests, like peacock feathers, serve as signaling displays.



AMERICAN MUSEUM OF NATURAL HISTORY

Feminine traits. A female dinosaur's first chevron seems shorter than a male's, and farther away from the pelvis.



Telling tail. The first chevron under the tail of a male *T. rex* may be longer than a female's chevron.

According to Philip Currie of the Royal Tyrrell Museum in Alberta, Canada, some features of the skull—such as the bones in back of the eyes—resemble theropod fossils from China and South America, but are different in their shape and relative orientation. The next step in sealing the status of the Antarctic dinosaur is to give it a new species name: The Augustana researchers are currently working on just such a christening project.

To Sex a *T. rex*

Peter Larson got interested in dinosaur sex when he pulled a massive *Tyrannosaurus rex* skeleton out of the ground in South Dakota 3 years ago and named it "Sue." The name came from the woman who first noticed the fossil, but Larson, president of the Black Hills Institute of Geological Research, a professional collecting outfit in Hill City, South Dakota, began to wonder whether the name really matched the fossil's gender. Sexing fossil skeletons has long been a thorny problem for paleontologists, but after examining 14 *T. rex* skeletons and making anatomical comparisons to large modern reptiles, Larson thinks the solution lies under the tail.

Larson began by dissecting a series of modern crocodiles, which share several anatomical features with dinosaurs. Male crocs, like many reptiles, have a penis-like sex organ that can be extended or retracted into the body, the muscles involved being attached to one of several bony spines, called chevrons, on the underside of the tail vertebrae. In male crocs, Larson found, the first chevron, which anchors the penis muscles, is the same size as the next chevron down the tail. In females, however, the corresponding chevron is shorter, presumably because it doesn't need to anchor the muscles. It's also positioned farther down the tail, away from the pelvis—perhaps, Larson speculates, to leave more room for eggs to pass.

An examination of the *T. rex* skeletons revealed similar features: Some specimens had a shortened first chevron, positioned farther down the tail. At Larson's request, Philip Currie of the Royal Tyrrell Museum took a look at several specimens of troodontids, close relatives of *T. rex*, and found the pattern again. The individuals with the larger chevrons, Larson concludes, must have been males, each equipped with a retractable penis.

These "male" skeletons were also consistently smaller than the "female" ones, with the shorter chevrons. That size pattern supports Larson's sex scheme, says Sankar Chatterjee, a paleontologist at Texas Tech University: "In many modern reptiles, and in birds of prey, the female is larger than the male."

And that means Larson doesn't have to consider a name change for Sue, whose big bones appear to be a sign of femininity. But he probably wouldn't have rechristened the *T. rex* even if massive dinosaurs appeared to be male. "Then," he says, "we simply would have had a boy named Sue."

–Joshua Fischman

ASTRONOMY

Cosmologists Meet to Face Their Fears

LONDON—The great Russian physicist Lev Landau once said that cosmologists are often wrong but never in doubt. That may have been true once, but after years of having observations refuse to agree with theories, there's no shortage of doubt in the field. Two of its most doubt-ridden issues—the age of the universe, and its composition—brought cosmologists together last month at the Royal Astronomical Society in London to compare their newest results and ideas. "There are quite a lot of new results coming in—new conceptual ideas and new measurements," says Ofer Lahav of the Institute of Astronomy at the University of Cambridge, one of the meeting's organizers.

But that doesn't mean that the conference relieved all the anxieties of cosmologists. While new measurements of the universe's age raised hopes that the cosmos can do without a mysterious antigravitational force—a notion that makes many cosmologists squirm—a new proposal about its makeup holds that that force may be an integral component of the cosmos.

The universe ages gracefully

One of cosmology's oldest problems has been squaring the seeming youth of the universe with the extreme old age of its oldest stars. At the conference, however, two groups presented data pointing to a far older universe—old enough to dispel the contradiction.

If the results hold up, they could also put to rest a specter that has long haunted cosmologists: the cosmological constant. Added to the gravitational equations of general relativity, the constant implies a mysterious force apparently generated by empty space that gently pushes galaxies apart. Einstein, who first invoked it, later dismissed the constant as a blunder, and many astronomers would agree with Tom Shanks of Durham University, co-organizer of the RAS meeting, who calls the constant "inelegant." But in recent years, some astronomers have called for its reinstatement, primarily to solve the apparent mismatch between stellar and cosmic ages.

Astronomers can't calculate the age of the universe directly; instead, they infer it from the rate of expansion of the universe, as measured by the so-called Hubble constant. A larger Hubble constant (faster expansion) implies that gravity has had less time to slow down the universe since the Big Bang, thus implying a younger cosmos. But measuring