Why such drastic overengineering? Rayfield suspects that the skull had to absorb such large forces when *Allosaurus* collided with its prey. She imagines *Allosaurus* running into a fleeing victim with jaws agape, slamming its upper teeth in like a hatchet and then using its strong neck muscles to rake out flesh with its teeth. "At first glance, it seems like it would be a weird approach to biting," says Tom Holtz of the University of Maryland, College Park. But it fits with the observation, published last year, that *Allosaurus* could open its jaws extremely wide. "It's appealing to see that the mechanical analysis is consistent," he says.

Such consensus is reassuring, because paleontological modeling is far from an exact science. The material properties of fossil bones and the applied forces are all estimates, and figuring out muscle strength is just part of modeling a complicated motion. As a result, paleontologists say they are on guard against the "garbage in, garbage out" effect. "I wanted solid answers," recalls Michael Fastnacht, a doctoral student at Johannes Gutenberg University in Mainz, Germany. "But when I went to the engineers, they said, 'Oh, no, even we don't get those.' " What's more, there's rarely a way to test a theory short of building a scale model of a dinosaur skull out of modern bone.

Still, for all the caveats, Fastnacht and colleagues are pressing ahead with plans to investigate the bony crests that grace the tops of some pterosaur skulls. The crests have been proposed as rudders for flying or buttresses to strengthen the snout during a bite. Other paleontologists talk about modeling foot bones of dinosaurs, and paleoanthropologists are interested in using the technique to study chewing and hip function in primates. It's not *Jurassic Park*, they acknowledge, but detailed answers from this high-tech approach may help bring these old bones to life. —**ERIK STOKSTAD**

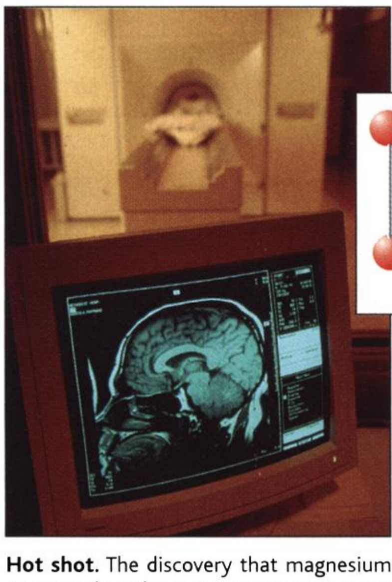
SUPERCONDUCTIVITY

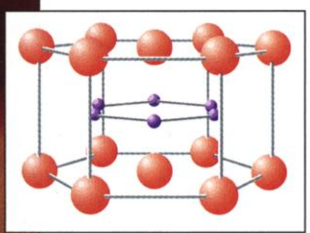
Material Sets Record for Metal Compounds

Magnesium diboride, one of the simplest compounds around, superconducts at nearly twice the temperature of its closest metallic rival

The discovery of ceramic superconductors in 1986 lit a fire under physicists worldwide. Experimentalists stayed up for nights on end concocting new ceramic mixtures and testing the results. Theorists jumped at the latest data and racked their brains trying to explain how the newfound ceramics could conduct electricity without any losses at temperatures far above those of the conventional metallic variety. Physics meetings took on the aura of jam-packed rock concerts. Now a new discovery, although clearly more modest, has the superconductivity community abuzz again.

At a meeting last month in Japan,* researchers led by physicist Jun Akimitsu of Aoyama Gakuin University in Tokyo announced that they had discovered a boron-containing metal compound that superconducts at 39 K, nearly twice the temperature of the previous metallic record holder. Although some ceramics can superconduct at temperatures up to 96 degrees higher, most metallic compounds are better at carrying current across gaps between grains of material and thus make better wires.





Hot shot. The discovery that magnesium diboride *(inset)* is a superconductor could mean more powerful, less costly magnets in MRI machines.

"This is the highest observed [superconducting temperature] of any intermetallic compound," says Paul Canfield, a physicist at Iowa State University in Ames, and the Department of Energy's Ames Laboratory. "That's a big hairy deal."

Researchers have spent decades looking at boron-containing compounds for hints of superconductivity, because theory suggests that boron's light weight should give any compound it is in a relatively high superconducting temperature. Yet somehow they overlooked one of the simplest compounds around, magnesium diboride (MgB_2), a tan powder that can be purchased from standard laboratory chemical suppliers. "I'm really amazed that they didn't find it before," says Jorge Hirsch, a superconductivity theorist at the University of California, San Diego. "It's like putting cinnamon in your magnetometer and finding it superconducts," marvels Canfield.

In an e-mail exchange, Akimitsu declined to provide details of his team's discovery or explain why they decided to look at MgB_2, because the team currently has a paper on the subject under review. In any case, the result has already been replicated by other teams in Japan, the United States, and the United Kingdom. Now physicists are racing to make sense out of MgB_2's abnormally high superconducting temperature.

Materials superconduct when electrons inside overcome their usual repulsion and pair up, with electrons effectively taking on the size of the paired structure. That property allows them to surf through a material's crystalline lattice without banging into atoms that would slow their progress.

According to the "BCS" theory of superconductivity, first outlined in 1957 by John Bardeen, Leon Cooper, and Robert Schrieffer, this pairing occurs in metallic superconductors as a result of a kind of electronic water skiing: The movement of one electron creates vibrations in the surrounding atomic lattice that then sweep another electron along in its wake. But this link between electrons normally breaks when the temperature rises much above 20 K. The heat produces extra vibrations that act like rogue waves sending the trailing electron skiers careering in all directions.

In high-temperature ceramic superconductors, electron pairing is widely thought to be due to the magnetic behavior of atoms in the material, although this remains in dispute. So figuring out what is keeping electron pairs together at nearly 40 K in the nonceramic MgB_2 has become the latest contest in the most competitive area of materials physics. "Tally ho," says Canfield. "The chase is on." Adds Hirsch: "I can't sleep. It's extremely exciting."

Hirsch's insomnia may be brief, however. A series of early reports suggests that MgB_2 is most likely a BCS superconductor, albeit a very good one. In one paper posted to the Los Alamos physics preprint server on 3 February and accepted for publication at *Physical Re-*

* Symposium on Transition Metal Oxides, 10 January, Sendai, Japan.

view Letters, Canfield and his Iowa State colleagues present experimental evidence of its similarities to other intermetallics, most of which can be explained by the BCS theory. The Iowa State team found that the top superconducting temperature of MgB_2 increases by a degree when they make the material with the lighter isotope of boron, boron-10, rather than boron-11. This "isotope effect" is a classic signature of a BCS superconductor. "This does not prove it's a BCS superconductor, but it supports it," says Canfield.

Other results are bolstering that support. Another Iowa State team—this one headed by physicist Doug Finnemore—reports in another Los Alamos preprint that other standard tests done on MgB_2, which track the way materials conduct heat and behave in a magnetic field, show that the material's behavior closely resembles that of Nb_3Sn, a popular intermetallic superconductor. And both Finnemore's team and one headed by David Larbalestier at the University of Wisconsin, Madison, report that MgB_2 can transport large electrical currents between separate grains in the powdery material, again a behavior similar to Nb_3Sn.

Still, not everyone is ready to call off the hounds. For BCS theory, says Hirsch, MgB_2 is "a big outlier," and it's not clear what makes its electron pairs stick together at such a high temperature.

No matter what the mechanism, MgB_2 could generate an even greater buzz in the real world. Despite the hype that accompanied the earlier high-temperature superconductors, low-temperature metallic superconductors continue to dominate the applications arena, because these materials can be fashioned into wires that carry large currents. Among the metallic superconductors, niobium-based superconductors reign supreme, because wires made from it are durable and can carry huge electrical currents. Yet niobium is expensive, whereas magnesium and boron are cheap.

Last week, Canfield and another team posted another preprint reporting that they've already made MgB_2 wire filaments that superconduct up to 39 K. As a result, magnesium diboride could find itself the superconductor of choice for a wide range of applications, such as the wires that make up the high-field magnets in magnetic resonance imaging (MRI) machines. That could make this newcomer far more useful than its high-temperature cousins. —ROBERT F. SERVICE

CHINESE ACADEMY OF SCIENCES

In China, Publish or Perish Is Becoming the New Reality

A new program is funneling money and resources to a chosen few who are found to be highly productive—but at the expense mainly of older researchers

BEIJING—Being one of the chosen is paying off for Wu Xiangping. The 39-year-old astrophysicist at the Beijing Astronomical Observatory (BAO) received a fivefold boost in pay last year for his theoretical work on the existence and function of dark matter, which is funded by three government agencies. He also secured a long-term, renewable contract as a team leader and the authority to pick the rest of his research group.

Things haven't worked out so well for a colleague, Li Xiaocong, who went through the same review that boosted Wu's salary and status. Two years ago, the 52-year-old researcher was forced to retire from the observatory's solar activities forecasting group and take a job at another institution that doesn't make use of her scientific skills. However, she's working on a paper that she hopes will restore her to the job she loves.

Wu and Li are two of the 305 scientists at BAO who have been through the first phase of a decade-long self-improvement regimen at BAO's parent body, the Chinese Academy of Sciences (CAS). Launched in 1998, the Knowledge Innovation Program (KIP) is the academy's attempt to tame a sprawling empire of 123 institutes that for almost 50 years provided not just jobs but a lifetime social support system for its 40,000-member workforce. That cradle-to-grave approach became an anachronism as China moved toward a market economy, leading CAS President Lu Yongxiang to order institutes to shrink their workforces, shed their nonscientific functions, eliminate unproductive research programs, and focus on their best scientists, including luring back those from overseas (*Science*, 30 January 1998, p. 649).

The shake-up is doing exactly what it set out to do: Create a cadre of elite researchers like Wu by channeling new funding to a chosen few. The first phase of the reforms has led to a 50% cut in staff at 76 targeted institutes. The second phase aims at a slimmed-down CAS of 20,000 researchers spread across 80 institutes. And it doesn't end there: KIP has also enshrined the principle of ongoing performance reviews, with the lowest performers—especially those older than 50—getting the boot. At the same time, some scientists complain that the quantitative measures being applied are too rigid to span all types of scientific activity.

Triage. BAO's Ai Guoxing trimmed his staff based on productivity; age was also a factor.

CREDIT: *CHINA FEATURES*

A key element in the reform is the government's promise to spend more on those who are the most productive. CAS has allocated nearly $600 million for phase I, a sharp increase over previous spending rates, and has budgeted $1.2 billion over 10 years, a figure that could grow. The support has meant an extra $15,000 per researcher, a princely sum. With one-quarter going for salaries, scientists in the program can earn three to four times more than co-workers not chosen for KIP. (Under the reform, some CAS researchers have kept their jobs and receive small amounts of money from their institutes' regular research budgets but nothing from KIP.)

In addition to selecting for quality, CAS hopes to deepen the talent pool by bringing in more young scientists. By 2005, the academy plans to create positions for 20,000 graduate students and 5000 postdocs and visiting scholars. That would be a big jump from current levels of 12,000 graduate students and 1500 visiting scholars. It also plans to invite 500 outstanding young scientists from abroad to work as long-term CAS employees. If deemed a success, the approach is likely to be copied by other scientific institutions, universities, and high-tech businesses.

The chosen

Although CAS determines the overall guidelines that each institute must follow, individual institute directors have great leeway in implementing the reforms. Most