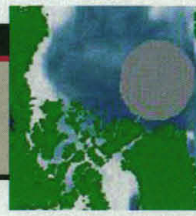
PAGE 1826
A step to spinal cord repair



1828
Arctic meltdown

ASTRONOMY

Shadow and Shine Offer Glimpses Of Otherworldly Jupiters

In a week of announcements colored by rivalry and bruised feelings, astronomers have assembled their sharpest picture yet of planets around other stars. Early last week, one group of observers said it had twice seen a giant exoplanet cross the face of its parent star. The finding confirmed a less certain claim by another group 3 weeks ago (*Science*, 19 November, p. 1451) and gave a precise fix on the planet's mass, size, and density. Only a small minority of exoplanets are likely to reveal themselves by making a transit across their parent star, however, whereas every exoplanet should reflect light. So astronomers were even more intrigued when another group posted a paper on the Web announcing the discovery of starlight reflected from the Jupiter-sized exoplanet orbiting the star Tau Boötis, affectionately known as Tau Boo.

The reflected light has yet to be confirmed. But if it is real, it agrees with data from the transits in showing that these exoplanets have densities close to Jupiter's: about one-third the density of water. The transits "establish unquestionably that this planet, and by extension, probably all the extrasolar giant planets detected to date, are like Jupiter in composition and structure," says planetary scientist William Hubbard of the University of Arizona, Tucson.

Before this flurry of observations, no one had ever seen an exoplanet. Roughly 28 are known—six were announced just last week—but in every case their presence was inferred from the wobbling of their parent stars induced by the gravitational tug of the orbiting planet. Although virtually every astronomer accepts the wobbles as good evidence of unseen planets, the nature of these planets has been the subject of heated debate. A dozen exoplanets weighing about as much as Jupiter orbit their parent stars at less than one-tenth of an astronomical unit (1 AU equals Earth's orbital radius), where the star's heat might either burn these "hot Jupiters" to dense rocky cinders or inflate them into extended gas giants. With no way to estimate the radius of these planets, astronomers could not tell.

But a planet whose orbit crosses the line of sight to its parent star should dim the star's light, by an amount that is a clue to its size. For planets orbiting close to their star, "there is about a 1 in 10 chance of getting the necessary alignment," estimates Harvard University astronomer Dave Charbonneau. Charbonneau and Tim Brown of the High Altitude Observatory in Boulder, Colorado, got lucky.

Hot and heavy. Artist's conception of the "hot Jupiter" that closely orbits the star Tau Boötis, roughly 50 light-years away. Observers may have spotted light reflected from this planet.

Observations in 1997 and 1998 had uncovered a slight wobble in the star HD209458 that suggested the presence of a planet orbiting the star once every 3.5 days. Brown and Charbonneau calculated that if the planet's orbit carried it in front of the star, it would transit on the nights of 8 and 15 September. (The passage on 11 September would take place in daylight.) The 1% dimming produced by a planet the size of Jupiter should be relatively easy to spot with a small telescope, they thought. "We used a 4-inch telescope with a CCD [charge-coupled device] camera that Tim Brown literally built in his garage," says Charbonneau.

Brown, Charbonneau, and their collaborators found that on the predicted nights, the luminosity of HD209458 dipped sharply, by slightly more than 1%, just when the planet should have been passing in front of the star, and remained nearly constant for several hours before climbing back up as the planet passed beyond the edge of the star. From the duration of the dimming, they could work out how the orbit was oriented relative to the line of sight—and thus how massive the planet had to be to produce the observed wobble of HD209458: 0.63 times the mass of Jupiter. And from the amount of dimming, they pegged its radius at 1.27 times larger than that of Jupiter.

That's somewhat smaller than the 1.6 times Jupiter's diameter that Geoff Marcy of the University of California, Berkeley, Greg Henry of Tennessee State University in Nashville, and their colleagues had calculated for the same planet based on the partial transit they observed on 7 November. But the scientific disagreement was a minor element in the furor that erupted on the Internet when Charbonneau and Brown announced their findings on 23 November, after their paper had been refereed and accepted by *Astrophysical Journal Letters*. Along with their announcement, the astronomers circulated an e-mail message complaining about Marcy and his collaborators. Charbonneau says he and Brown believed that group had unfairly scooped their discovery and in the process violated scientific ethical standards by announcing their unrefereed results in a press release more than 10 days earlier.

Marcy acknowledges that when he approved the press release, he was aware that Brown and Charbonneau had searched HD209458 for transits in August and September, although he did not know what they had found. But after their complaints, he quickly admitted his error in proceeding with the release without waiting. "I believe this constituted a breach of collegial standards on my part and an ethical mistake," Marcy said in another e-mail. Over the Thanksgiving weekend, Brown and Charbonneau accepted Marcy's apology and declared the matter closed.

The week's second major planet discovery also had its share of controversy, al-

CREDIT: LYNETTE COOK

though in this case it was purely scientific. A team led by Andrew Cameron of the University of St. Andrews in Scotland reported that in observations at the 4.2-meter William Herschel Telescope in the Canary Islands, they detected a glimmer of starlight reflected by the planet thought to be orbiting Tau Boo. In their paper, released last week on the Los Alamos National Laboratory's preprint server (xxx.lanl.gov; see astro-ph/9911314), Cameron's team reported that the amount of light reflected by the planet indicates that it must be about twice the size of Jupiter. They also teased from the signal the planet's orbital inclination, and thus its mass: eight times that of Jupiter. (Their posting indicated that the paper was under embargo by *Nature*, where it had been accepted for publication, but the embargo did not last long; stories about the find appeared on several Web sites, including that of the British Broadcasting Corp.)

Charbonneau, for one, was surprised to hear the news. Several months earlier, he and his collaborators had observed Tau Boo at the 10-meter Keck Telescope on Mauna Kea in Hawaii and failed to see any reflected light. "Something just doesn't jive between our two results," says Lick Observatory astronomer Steven Vogt, a member of Charbonneau's team. But no one is crying foul in this controversy, mostly because identifying reflected light from the glare of a star is so challenging that success or failure can turn on the most minute of assumptions.

The object of the search is a faint ghost of the parent star's spectrum that appears to jiggle back and forth, from longer to shorter wavelengths, in time with the star's orbital period—3.3 days, in the case of Tau Boo. The ghost is the small portion of the star's light reflected from the planet, and the jiggle is the result of the Doppler shift—the motion-induced wavelength change that makes the pitch of a car horn rise and fall as the car approaches and then recedes. Why only Cameron's team saw this telltale ghost, no one is quite sure.

"Charbonneau did everything correctly, but Cameron's result is pretty compelling," says University of California, Berkeley, astronomer Debra Fischer, the leader of the Lick Observatory planet search team. "It is a very suggestive result," agrees Charbonneau, "but by no means conclusive." Charbonneau says he can't tell from the paper exactly how Cameron's team analyzed its data, "and it is really the nitty-gritty that sets the level of confidence."

Cameron declined interview requests, citing *Nature*'s embargo policy. But even Charbonneau is confident that conclusive evidence for reflected light from the Tau Boo planet will be found shortly. "We just need more telescope time," he says.

–MARK SINCELL

Mark Sincell is a science writer in Houston.

MOLECULAR BIOLOGY

Member States Buoy Up Beleaguered EMBL

A financial crisis facing the European Molecular Biology Laboratory (EMBL) in Heidelberg, Germany, and one of its key outstations has edged closer to resolution. Last week, EMBL's governing council, made up of delegates from the lab's 16 member countries, agreed in principle to meet the costs of a multimillion-dollar pay claim by staff members dating back to 1995. The council also tentatively resolved to cover a shortfall next year in the infrastructure budget of the European Bioinformatics Institute (EBI) near Cambridge, U.K., caused by a recent decision by the European Union to stop funding its share of the infrastructure costs for the EBI and several other European research facilities (*Science*, 5 November, p. 1058). Britain's Medical Research Council (MRC) has also come to EBI's aid with an offer to loan the center stopgap funds.

Troubled home. EMBL's council reacted positively to the lab's financial travails.

CREDIT: EMBL

EMBL and EBI are far from being home free, however. Last week's resolutions—which will not be implemented before the council's next meeting in March 2000, so that delegates can see if their own governments are willing to allot the additional EMBL funding needed—leave some key issues unresolved. EMBL is forced to pay retroactive pay increases because the administrative tribunal of the Geneva-based International Labour Organization (ILO) recently ruled that the lab had violated its own staff guidelines by setting 1995 salaries too low. But the ILO judgment leaves ambiguous exactly how much money is due in back payments. One interpretation would mandate EMBL to boost 1995 salary levels by an average of 8%. When back pay and the 10% annual interest awarded by the tribunal are factored in, this would amount to an immediate payment equivalent to a quarter of EMBL's annual core operating budget of about $43 million. (Cases concerning 1996 and 1997 salary levels are still pending before the ILO and could cost the lab even more.)

The other interpretation, which EMBL's council and management are fervently hoping will win out, would require an average boost in 1995 levels of only 2.1%. At its meeting, the council agreed to make funds available to cover this less costly scenario while asking the ILO to clarify its ruling, a process that will take at least 6 months. Cell biologist Julio Celis, chair of the council and head of the Center for Human Genome Research in Århus, Denmark, told *Science* that the council's main concern was "to keep the morale of the staff high," but it is at this point only prepared to pay the 2.1% figure and has directed EMBL director-general Fotis Kafatos to prepare a contingency plan for its March meeting in the event the ILO tribunal says it must pay 8%.

Concerns over the impact of such payouts on EMBL's scientific program have prompted many staff members to accept the 2.1% figure. "This would provide a fair solution to the problem," says molecular biologist Matthias Hentze, who was one of the original complainants before the ILO. On the other hand, Hentze says, he understands the dilemma of many EMBL staffers—particularly nonscientific workers—who are trying to cope with Heidelberg's high cost of living on relatively low salaries. But even if all of the present staff could be persuaded to accept a compromise, any one of a large number of former EMBL employees could still challenge the deal before the ILO. "The basic principle here is the rule of law," says one former EMBL scientist who asked not