

# The Year in Science (2004/05)

By Chris Lawson

## A terrestrial exoplanet

The sun-like star Gliese 876 is just 15 light-years away. As the planets orbit the star, they move it around, which creates a measurable Doppler effect in the starlight. The Doppler shifting of the starlight indicates that there is probably a small inner planet 6-8 times earth-mass, with an orbital period of 46.5 hours and a 0.021 AU moderately eccentric orbit. This is unlikely to be a gas giant, so it represents the first discovery of a rocky, so-called "terrestrial" exoplanet around a sun-like star.

Rivera E, Lissauer J, Butler RP, Marcy GW, Vogt S, Fischer DA, Brown T, Laughlin G. A 7.5 Earth-Mass Planet Orbiting the Nearby Star, GJ 876. *Astrophysics Journal*, **accepted** 2005

## The first visual image of an extrasolar planet

Gemini North Telescope has recorded what may be the first direct visual sighting of an extrasolar planet around the white dwarf G29-38. The candidate planet appears to be five times the mass of Jupiter and orbiting at about 70 AU, which is further than Pluto's orbit around the sun.

Debes JH, Sigurdsson S, Woodgate BE. Cool Customers In The Stellar Graveyard I: Limits To Extrasolar Planets Around The White Dwarf G29-38. *ArXiv preprint archive*, 2004

### A new Jupiter in a triple-star system

It should be impossible according to accepted models, but triple-star system HD 188753 appears to have a planet just a little larger than Jupiter. The candidate planet orbits its main anchor every 80 hours at a distance of 0.05 AU. The planet closely orbits the big star of the system, while the other two stars are closely bound to each other, orbiting as a subsystem in the larger system. The existence of this planet poses problems for current theories of planet formation because the smaller two stars are so close to the main star that they should have swept up all the primordial dust in the inner system, leaving nothing to coalesce into a gas giant.

Konacki M. *Nature*, **436**, 230 - 233 (2005)

### Dinosaurs breathed like birds

An exceptional fossil of the small carnivore *Majungatholus atopus* shows air sacs that are almost identical to those found in modern birds. It is likely that tyrannosaurs, allosaurs, and other theropod dinosaurs shared the same respiratory system. Many palaeontologists believe that dinosaurs breathed by the "hepatic piston" method found in modern crocodiles. Now it appears that theropod dinosaurs had air sacs much like birds. The findings are yet to be confirmed, but if true, bird-like breathing would make the ancient dinosaurs lighter, faster, and metabolically more active.

O'Connor M, Claessens L. Basic avian pulmonary design and flow-through ventilation in non-avian theropod dinosaurs. *Nature* **436**, 253-256 (14 July 2005)

### Did tyrannosaurs have feathers?

A 130-My old fossil of the tyrannosauroid *Dilong paradoxus* shows markings suggestive of downy feathers. *Dilong* is a small tyrannosauroid. The largest known

specimen is 1.6 metres long. The fossil shows "filamentous integumentary structures" that may represent feathery formations around the tail and the jaw. Since skin features such as feathers are rarely preserved by fossilisation, this is a rare finding and it may indicate that feathers or protofeathers were a common feature of the entire class of tyrannosauroids, maybe even including the great *T. rex*.

Xu X, Norell MA, Kuang X, Wang X, Zhao Q, Jia C. Basal tyrannosauroids from China and evidence for protofeathers in tyrannosauroids. *Nature*: **431**, 680-4 (7 Oct 2004)

### US-funded HIV programs in Africa do more harm than good

A searing paper in *The Lancet* condemns the programs funded by US President George W. Bush's Emergency Plan for AIDS Relief, which promotes abstinence and while formally recommending condom use, devalues it with comments such as "using condoms is like using a parachute that only opens 75% of the time." Abstinence-before-marriage HIV prevention is based on studies that are either flawed or ideologically driven, and the education materials often give false and misleading information in language that demonises condom use and homosexuality. Recent material provided by US funding described anal sex only briefly under the heading of "Morally unacceptable sexual behaviour." Even if abstinence-before-marriage programs worked as well as they are claimed to, they would still fail to protect women who contract HIV through sex with their husbands, targets of rape or coerced sex, prostitutes, and homosexuals and lesbians. The Uganda AIDS Commission declared that it had no mandate to prevent HIV in gays and lesbians as these sexual activities were not recognised by law.

Cohen J, Schleifer R, Tate T. AIDS in Uganda: the human-rights dimension. *Lancet* **365**: 2075-6, 7 July 2005

## Shark cartilage harms cancer patients, sharks

Shark cartilage was supposed to cure cancer. The popular belief was that sharks don't get cancer and some of the early animal studies seemed to show a benefit. But a new study – the first well-designed double blind placebo-controlled trial – shows that patients with colorectal cancer or breast cancer randomised to shark cartilage survived no longer than placebo users, and they felt a lot worse. Only one in ten could last more than 6 months before abandoning the treatment due to diarrhoea, heartburn, or bone pain. Instead of curing cancer, shark cartilage makes people sicker and reduces their white blood cell count at a time when they are highly vulnerable. The boom in demand for shark cartilage has also been disastrous for sharks, especially as it coincides with a surge in demand for shark fin soup. Shark fishing and "finning" has caused a doubling of the shark catch since 1980, and in some areas the shark populations have dropped by 80%. Sharks are high-level predators, so the oceans cannot support a large population of them, and they have a long reproductive cycle of up to 30 years, all of which means that sharks take a very long time to rebound from environmental disasters.

Loprinzi C, et al. Evaluation of shark cartilage in patients with advanced cancer: a North Central Cancer Treatment Group trial, *Cancer* **104**: 176-182, 1 July 2005

## McNeil's Nebula

Amateur astronomer Jay McNeil pointed his telescope at Orion and noticed a glowing object that shouldn't have been there. What he discovered was a new nebula – but unlike the Crab Nebula, this sudden development was not caused by a supernova blasting superheated gas into space. McNeil's nebula is the result of a star's light reflecting off the cloud of interstellar gas from which the star coalesced. When

astronomers went back to their photographs, they found no sign of McNeil's nebula before 2003...until they looked back as far as 1951, where it may be seen again. Astronomers are currently trying to decide if McNeil's Nebula is from the light of a brand new star that has just ignited, or if it is the result of a massively unstable variable star.

Reipurth B, Aspin C. IRAS 05436-0007 and the Emergence of McNeil's Nebula. *ArXiv preprint archive*, 2004.

### Sex and the single vole

Two closely related species of voles have very different mating patterns. Prairie voles live in life-long monogamous partnerships while meadow voles are solitary and promiscuous. The difference in brain chemistry was identified as being due to a small variation in a single gene responsible for the vasopressin V1a receptor. When the gene from the prairie vole was introduced to the brains of meadow voles, the promiscuous species started to display pair-bonding.

Lim M, Wang Z, et al. Enhanced partner preference in a promiscuous species by manipulating the expression of a single gene. *Nature* **429**: 754 – 757, 17 June 2004

### Human language and the squeakless mouse

In 2001, a Pakistani family's tendency to have trouble generating grammar was pinned on a single gene called *Foxp2*. Mice with damage to the *Foxp2* gene develop normally except for an inability to communicate by squeaking. The mouse version of *Foxp2* is 92% identical to the human version of the gene – and so is the chimpanzee version. That is, the *Foxp2* gene has evolved enormously rapidly in humans. In fact, almost all of the evolution of the *Foxp2* gene took place around 100,000 years ago,

which coincides with archaeological evidence suggesting that was the time humans first developed modern speech.

Shu W, Cho JY, Jiang Y, *et al.* Altered ultrasonic vocalization in mice with a disruption in the *Foxp2* gene. *Proceedings of the National Academy of Sciences* **102**: 9643-8, 5 July 2005

### Fire ants: sex and the exploitation of the working class

Ants have an unusual method of reproduction called haplodiploidy. Male ants come from unfertilised eggs, which means they only have half the normal number of chromosomes. Female ants are made from fertilised eggs, so they have the full complement of chromosomes. The result of this unusual method is that female worker ants are all sisters, and they share  $\frac{3}{4}$  of the genes of their fellow sisters, as opposed to the  $\frac{1}{2}$  share found in most sexual animals. This means that worker ants are more closely related to each other than they are to the queen of the nest. This genetic similarity is used as an explanation for the extreme socialisation in many ants.

There are many variations of the social arrangements of ants, but the little fire ant *Wasmannia auropunctata* has a variation that is unprecedented in nature. The fire ant has lost two of the normal reproductive pathways and gained two parthenogenetic pathways. The result is that the ant reproduces parthenogenetically and that the male lineage never mixes with the female lineage. Female workers are still produced sexually, but as they are sterile, their genetic mixing does not get passed on to the next generation. Female queens are clones of each other, the males are clones of each other, and the two streams appear to never converge (although this requires confirmation). It seems that the only reason the queens and the males persist in cohabiting is to create workers for the colony.

Fournier, D. *et al.* *Nature* **435**, 1230-1234 (2005)

## Planets, moons, and kamikaze space probes

An amazing year for space probes. Cassini does Saturn. Clementine does the lunar poles – via a chaotic approach orbit. Deep impact does Comet Tempel 1. Spirit and Opportunity do Mars.

## Other stories

Tool-using crows. 40,000 year old footprints in America. Tiny hominids in Flores. Quantum teleportation across the Danube. Dark hydrogen galaxy found in the Virgo Cluster. No sign of an asteroid impact at the end of the Permian. The deadly H5N1 bird virus spreads to cats, kills 23 tigers in the Sri Racha zoo in Thailand. Genetic engineering creates circadian oscillators.

## Disclaimer

Many of these reports are fresh off the press. Some were published the week before this presentation was written. These findings have not yet been replicated and may turn out to be misinterpreted or incorrect. Even if they are correct, they may turn out to have a more mundane explanation than proposed here. As a general rule, the more exciting and unexpected a new finding is, the more likely it is to be revised in the near future.