"Science journalists don't get to witness earlier drafts of history-making because these are part of the peer-review process." Toby Murcott, page 1054

However, the concept of free will may become confused if it is linked with an absence of determinism.

As an example, let us consider three schoolgirls, X, Y and Z, confronted with the proof of Pythagoras's theorem: X has a talent for mathematics and enjoys working out proofs; Y is weak in this domain and is unquestioning; Z has average ability but her decisions are capricious. The teacher instructs them to believe the theorem because it is correct. Y accepts it immediately, X first confirms for herself that the proof is valid, but Z (possibly influenced by a 'quantum event' in her brain) refuses to agree. Although the behaviour of X and Y is predictable and determined, given their personalities and abilities, Z's is not.

Heisenberg's suggestion would support the conclusion that only Z's decision was 'free'. But X could be judged as the one who made the really free (autonomous) decision. Y's decision is formally free, having been determined by her accepting nature, but it is undermined because it stems from the teacher's authority. Z's reaction is not free at all, because it was not determined by Z herself but by a random event in one or more of her brain cells.

In short, deciding freely does not imply a lack of determinism — rather, it is determined by central aspects of our personality: our long-term needs, the emotions accompanying their non-fulfilment, and our rational thinking about the means to satisfy those needs. Our decisions may therefore not be completely free, because they are not always exclusively determined by these central (core) factors. A person who stops smoking on rational grounds is freer than another who makes a decision to stop but fails to do so.

Quantum events have no relevance here: the question is whether we are influenced more by our core factors than by drives that are not rationally founded, such as habit, addiction or external pressure. Consciousness and the experience of positive or negative emotions could well play a part in our decisions: in my opinion, these are not epiphenomena — mere parallel events — but essential for bringing about determining factors that underlie our free will. This would not exclude a purely naturalistic explanation of the processes that we experience as consciousness.

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Readers are welcome to comment at http://tinyurl.com/m2ybmo

How air capture could help to promote a Copenhagen solution

SIR — Your News Feature 'Sucking it up' (*Nature* **458,** 1094–1097; 2009) reports on the issue of the capture of carbon dioxide from air. This is timely, as in February this year, President Obama and the Canadian Prime Minister, Stephen Harper, agreed to work together on carbon capture and sequestration as part of an effort to build a North American environmental and energy accord. US and Canadian government funding for 'carbon capture and storage' (CCS) projects has ballooned during the past six months, and in May the US energy secretary, Steven Chu, announced CCS funding of $2.4 billion, which specified for the first time "CO_2 capture from the atmosphere".

Conventional CCS has been used successfully since 1996, but it has many critics. It has been blocked in global climate negotiations and is likely to be a contentious issue at meetings of COP15 — the conference of the United Nations Framework Convention on Climate Change, to be held in Copenhagen in December this year — which will decide on the future of the Kyoto Protocol after 2012.

Opposition to CCS, and support for the attendant 'cleaner coal' approach, is motivated by incentives to continue using fossil fuels, rather than making the transition to renewable sources of energy, and by the effort needed to retrofit and clean up existing fossil-fuel plants, which are responsible for more than 40% of global emissions. In new power plants, conventional CCS can at best neutralize carbon emissions.

Air capture could satisfy these critics, as well as potentially strengthening the president's proposal. The technology is under evaluation by the American Physical Society and is rapidly gaining support in the business community. It will encourage nations to cooperate at global negotiations, including China and developing countries, because the ubiquity of air means that this technology can be used by everyone; small emitters such as Latin America and Africa will be able to decrease their atmospheric carbon beyond what they actually emit. When driven by renewable energy, air capture will help the transition to renewable energy. Incorporating air capture into the Clean Development Mechanism of the Kyoto Protocol would be a big step forwards.

Two footnotes to your News Feature are in order. First, G.C. is co-inventor and co-owner of the air-capture company Global Thermostat's technology. Second, P.E.'s mention of how much it might cost on a global scale to reduce CO_2 is only an estimate — specific costs for the company's technology are awaiting data from the commercial demonstration plant that is to be built in the near future.

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Planck's power lies in its unique instrument combination

SIR — Your News Feature 'The test of inflation' (*Nature* **458,** 820–824; 2009) highlights some of the exciting scientific data to be collected by the European Space Agency's Planck spacecraft, and the theoretical issues underlying its objectives to study the moments after the Big Bang.

You discuss the new high-frequency 52-bolometer detector, but do not mention the 22-radiometer low-frequency instrument (LFI). However, it is this unique combination of Planck radiometers and bolometers in an integrated focal assembly that is key to achieving the broad spectral coverage needed to separate foreground emission of galactic and extragalactic origin from the cosmological signal.

This feature is essential in searching for subtle signatures in the cosmic microwave background, including possible clues from an inflationary era of the Universe (such as polarization B-modes and non-Gaussianity). Planck's 70-gigahertz radiometers will observe the sky in the frequency band that is least contaminated by foregrounds, and with a sensitivity and angular resolution surpassing that of all previous experiments.

Following the 1989 Cosmic Background Explorer differential microwave radiometer and the 2001 Wilkinson microwave anisotropy probe, the Planck radiometric instrument will use polarization-sensitive detectors based on indium phosphide HEMT (high electron-mobility transistor) cryogenic amplifiers cooled to 20 K. It is the data from these detectors, combined with the bolometer data, that will give Planck its superiority over its predecessors.

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