

Correspondence

Fiscal cliff is bad news for US science

I strongly disagree with Colin Macilwain's claim that the US 'fiscal cliff' represents "the least-bad outcome — for both US society and US science" (*Nature* **491**, 639; 2012). Scientists cannot assume that we shall survive cuts just because we did in the past, that the percentage of the US budget allocated to research and development will remain unchanged or that discretionary spending will rise in the future.

The expiration of tax cuts from the George W. Bush era should not be conflated with the Budget Control Act (BCA): ultimately, one or both of these triggers could end up being pulled. This is what happened on 1 January, when Congress eliminated tax increases for many Americans but left most spending cuts in place.

The BCA makes mandatory, across-the-board cuts to government programmes and establishes spending caps for the next ten years. The 1 January legislation delays the cuts for two months, but the BCA caps ensure that competition for discretionary funding will become much more intense. And although the BCA includes defence programmes, there is no guarantee that these will not be protected by Congress in the future at the expense of cuts to non-defence agencies, including the US National Institutes of Health (NIH).

The NIH faces unprecedented budget cuts of at least 8%, and no one knows exactly how the 27 NIH centres will reprioritize their spending. Yet research projects will still be curtailed or shelved, thousands of jobs will go and promising research careers will end. Macilwain's remark that this is "not pretty, but not exactly penury" seems callous and inappropriate.

The Federation of American Societies for Experimental Biology (FASEB; of which I am public-affairs director), along with hundreds of other groups in the research and education

communities, reminds Congress, the administration and the US people that research investment is vital to our nation's future.

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A shortage of fertilizer resources?

Jeremy Grantham sounds an unnecessary alarm about the "impending shortage" of phosphorus and potassium fertilizers (*Nature* **491**, 303; 2012). With phosphorus constituting 0.1% of the lithosphere and potassium 2.5%, supplies are likely to outlast our species and possibly even the planet itself.

Grantham assumes that mineral-reserves numbers are indicators of resource availability. However, 'reserve' is an economic and legal concept that has nothing to do with the quantity of material available (see go.nature.com/2zhzqf).

A reserve represents the amount of an ore or element that has been drilled, tested, measured and defined, and which can be extracted using current techniques and profitably at current prices. It costs a great deal to confirm all those points for a particular mineral deposit, so it is done only for those likely to be used in the coming decades.

'Resource', by contrast, denotes the amount of the same ore or element that is out there, with prior knowledge of roughly where it is, how much there is and how it might be extracted. Resources are transformed into reserves by spending money — when that is strictly necessary. Every generation exhausts its reserves of almost all minerals, because the tendency is to convert only enough resources into reserves to last for a generation.

Resources of phosphate and potassium fertilizers are sufficient for thousands of years of current usage. On that timescale, total element availability is probably more important as a limit.

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Jeremy Grantham replies:

Phosphorus in Earth's crust is indeed relatively plentiful, but not in the context of feeding a future 9 billion people. Only about 0.5 parts per million of phosphorus occur in phosphate rock deposits that can be extracted economically (D. Cordell and S. White *Sustainability* **3**, 2027–2049; 2011), and the richest deposits are rapidly being depleted.

The price of phosphate rock has risen 4.3-fold in 10 years. The 'big agriculture' style of US farming is demanding ever-increasing quantities of phosphates. This must change, or millions more people will be priced out of the fertilizer and grain markets.

Patients self-treat with parasitic worms

Joel Weinstock discusses the use of parasitic worms (helminths) as a therapy for human autoimmune disease (*Nature* **491**, 183–185; 2012). We contend that using a pseudo-pharmaceutical process to evaluate helminth therapeutics — which typically costs millions of dollars and takes more than a decade to pass through clinical trials — is not the only way.

Individuals with chronic autoimmune disease often seek their own solutions, rather than wait for uncertain and complex approval processes or face unpleasant palliative therapies, side effects and surgery. Some UK patients with Crohn's disease, for example, are sourcing helminths, gathering data and sharing their experiences through online forums (our unpublished findings). As in the development of early therapies for AIDS, user practice is — rightly or wrongly — being driven by extreme need and is moving faster than formal scientific understanding.

A different approach to helminth therapeutics might

be to allow patients to help with development, using their insight and evidence in a revised model that better reflects patient behaviour and capabilities.

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China's new leaders offer green hope

China's scientists have high hopes that the country's new leaders (*Nature* **491**, 161; 2012) will accelerate efforts to tackle environmental pollution.

The proportion of China's Politburo Standing Committee (PSC) educated in economics and social science has increased to 86% from 22% in 5 years. This jump reflects the social problems caused by the country's rapid development from an agricultural economy (*Nature* **488**, 261–262; 2012).

Engineering solutions to water pollution and scarcity, for example, include construction of large reservoirs and transfer of water between river basins, but these have come with serious socioeconomic and environmental costs.

China's new leaders should recognize that non-structural approaches can be more sustainable and ecologically beneficial (P. H. Gleick *Water Int.* **25**, 127–138; 2000). With almost one-third of PSC members also having a legal background, green protests about pollution and resource management can now be properly handled through the judicial system.

As well as increased investment, prescient actions through effective legislation are needed to deliver sustainable long-term economic benefit.

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