

Representative Paul Ryan (Republican, Wisconsin) and Senator Patty Murray (Democrat, Washington), chairs of the House and Senate budget committees, respectively. In the aftermath of last autumn's government shutdown, Ryan and Murray negotiated an overall budget figure of US\$1.1 trillion that eases some of the sequester cuts beloved of Republicans while excluding unemployment benefits favoured by Democrats. In the process, they faced down claims of betrayal from both sides.

Arguably, even more credit is due to Representative Hal Rogers (Republican, Kentucky), who chairs the House appropriations committee, and Senator Barbara Mikulski (Democrat, Maryland), chair of the Senate equivalent. They had the unenviable job of allocating the overall budget among specific departments and programmes. These two politicians disagree on almost every issue. But they had the sense and judgement to agree on this: even leaving aside the disaster of the shutdown and the mindlessness of the sequester, Congress cannot keep on funding the government year to year with 'continuing resolutions' that avoid making choices, and instead keep programmes going on a yearly basis just as they were. The result is waste, turmoil and missed opportunities in the agencies, in which demoralized officials are forced to defer long-planned initiatives, hoard the money they do have and spend their days endlessly planning and replanning.

Once Ryan and Murray's overall budget number was in hand, Rogers, Mikulski and their staff worked almost non-stop to agree on allocations. They both had to deal with members of their own parties who wanted to attach amendments promoting this or that pet cause, and plenty of those measures did make it into the final bill. But they managed to fend off the worst of the 'poison pill' amendments that were designed to force the opposite party to vote against the final package — including one that would have blocked the Environmental Protection Agency from

regulating greenhouse-gas emissions to fight climate change.

Finally, credit is due to the rank-and-file members of Congress who passed the budget bill by overwhelming bipartisan majorities — despite threats from staunchly partisan political groups to use those votes against members in the upcoming November elections, when every Representative and one-third of Senators will face the voters.

The problem now is that the current spending agreement runs only until 1 October, the start of fiscal year 2015. If no new overall budget is agreed, the dreaded sequester will return, and with it the automatic, widespread budget reductions totalling roughly \$100 billion every year until 2023. Rogers and Mikulski have vowed to pursue a new agreement as part of their wider intention to continue Congress' return to normal procedure. But in an election year, it is not clear whether they will have enough time. To allow everyone ample opportunity to campaign, the House is scheduled to be in session for only 113 days this year, and the Senate for just less than 200. Nor is it clear how much courage anyone will maintain once the negative campaign adverts start flying.

Ultimately, it may come down to how well individual members of Congress learned the lessons of the shutdown, which sent public-approval ratings for their institution spiralling into the single digits late last year. If memories are short, and members sink back into a miasma of mistrust and gridlock, then sequestration looms.

Instead, if they can return to behaving like rational adults, then there is hope. Perhaps Congress can start making the kind of investments in research, education and infrastructure, such as broadband and smart grids, that both parties say are needed — and that foster the kind of economic growth that both parties say they want. ■

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A question of time

Timekeeping is boosted by the advent of an optical clock based on strontium atoms.

When the history of the twenty-first century comes to be written, one of the most puzzling questions asked will be why, well into the information age, millions of people still paid to dial a number on their phone to find out the time. Almost 80 years after its formation, the UK speaking clock, the world's original telephone time service, remains an essential part of British life. This is despite the near ubiquity of time displays — not least on the mobile phones that people discard to call 123 from a fixed line.

For some people, at some times, accuracy matters. Peaks in the use of the speaking clock come, for instance, on New Year's Eve, or when the clocks are put forward and back by an hour to mark, respectively, the start and end of British Summer Time.

There is another way, at least in Britain. BBC Radio regularly broadcasts the same time signal used to set the speaking clock — affectionately known as the pips. Indeed, it has become as much a feature of some shows as the content planned around it. Time is more than a British institution; it is woven into the cultural fabric of everyday life.

The pips are drawn from an atomic clock held at the National Physical Laboratory (NPL) in Teddington, near London. One of the most accurate in the world, the NPL clock is tuned to the regular bursts of light emitted by caesium atoms when they are excited by microwaves. The clock would lose roughly one second every 138 million years — a sufficient degree of accuracy for a bleary-eyed hour-late commuter who forgot to set their clock the night before, but not accurate enough for some.

In a paper published on *Nature's* website this week, time lords in the United States describe the latest advance in chronometry, and one that is as superior to the atomic pips as those pips were to the mechanical devices they replaced (B. J. Bloom *et al.* *Nature* <http://dx.doi.org/10.1038/nature12941>; 2014). The researchers have built a timepiece based not on caesium but on strontium. More importantly, it uses much higher, optical frequencies. This gives such devices, called optical clocks, greater accuracy than those that rely on microwaves. The new optical clock, for example, would not lose one second even if it were to run for 5 billion years.

It is also extremely stable — another key measure of timekeeping. (Accuracy defines how closely a clock's output matches the desired time signal, whereas stability is a measure of how steady that output is. A clock that loses precisely one second each day is inaccurate but stable, for example.)

The unveiling of the super-accurate strontium optical clock comes just a few months after a related group revealed a device based on ytterbium. Other laboratories across the world have their own designs. Inevitably, the increased precision and reliability of optical clocks are fuelling debate about whether they could be used to set the ultimate time, and redefine the second. (There are no official plans to do so, but plans are afoot to redefine other SI units.) These are heady times for metrology: a World View on page 455 describes attempts to measure another fundamental constant: Big G.

Nature has a particular stake in the race to develop new atomic clocks. Back in January 2003, we published a News Feature that surveyed the scene and tried to predict what would happen (D. Adam *Nature* **421**, 207–208; 2003). Within a decade, the piece suggested, optical clocks could rise to prominence and raise fresh debate about the definition of

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the second. A ten-year event horizon is a staple of scientific journalism, and most promised breakthroughs fail to materialize on deadline. The latest development in atomic timekeeping, by contrast, has arrived bang on time. Well, almost. ■