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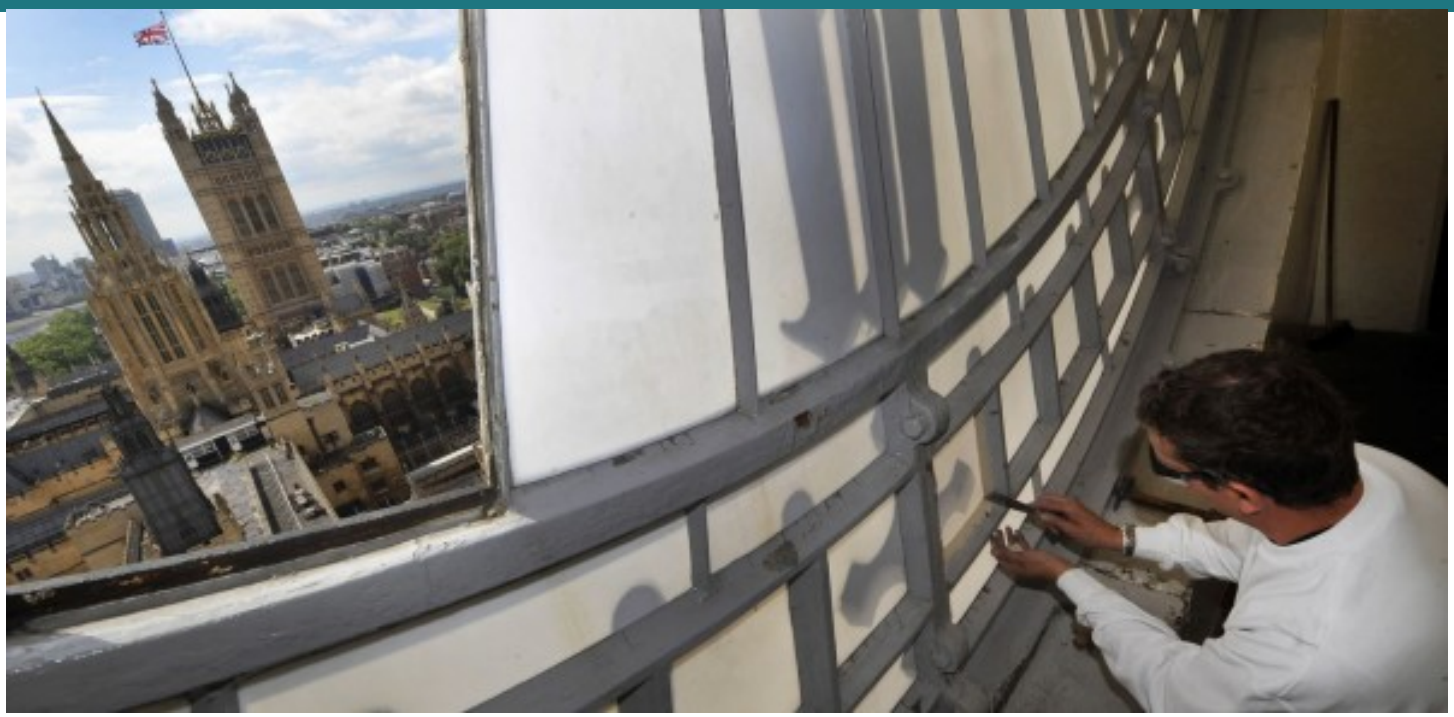
Inside Big Ben: why the world's most famous clock will soon lose its bong



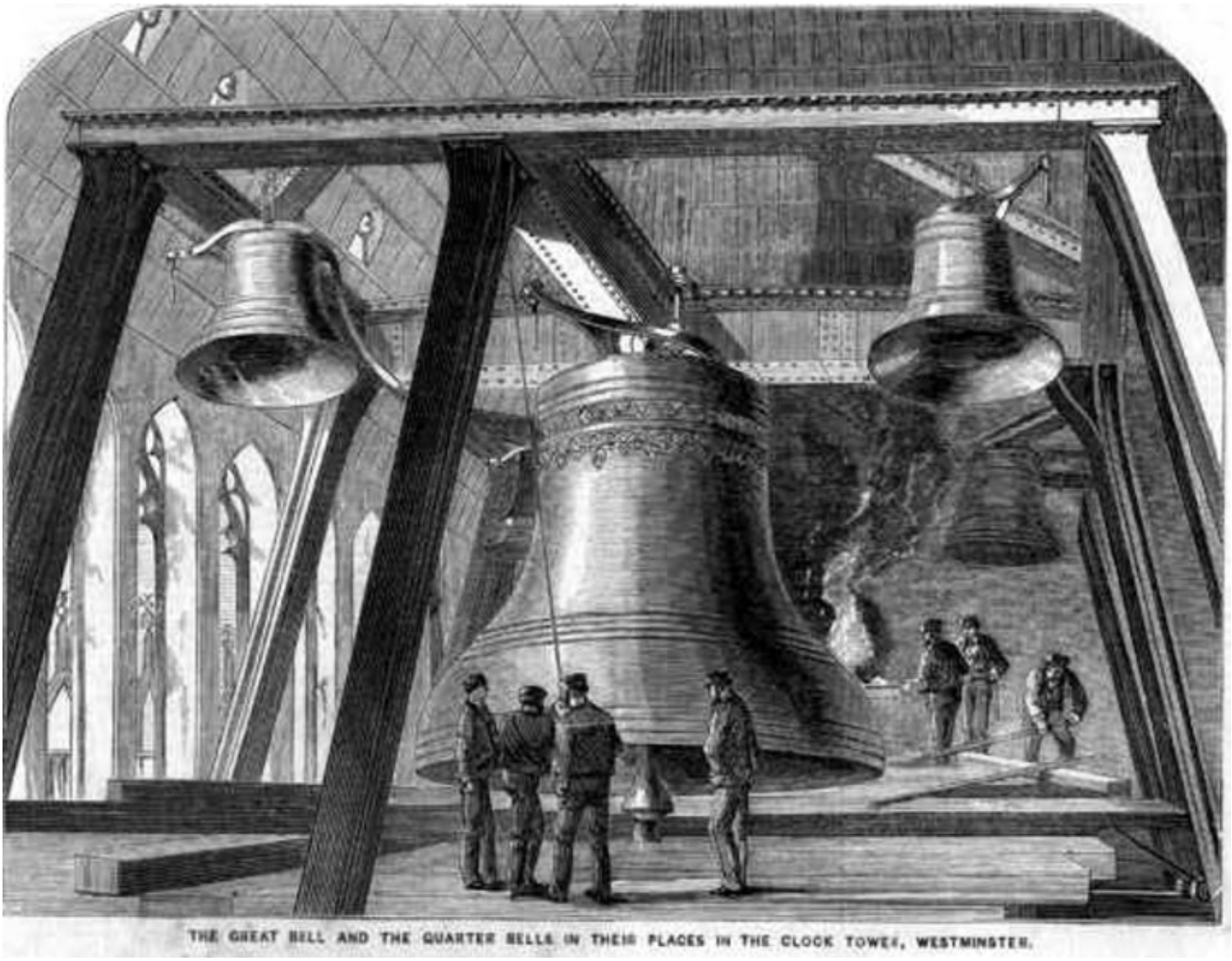
London is soon going to lose one of its most familiar sounds when the world-famous Big Ben falls silent for repairs. The "bonging" chimes that have marked the passing of time for Londoners since 1859 will fall silent for months beginning in 2017 as part of a three-year £29m conservation project.

Of course, "Big Ben" is the nickname of the Great Bell and the bell itself is not in bad shape – even though it does have a huge crack in it. The bell weighs nearly 14 tonnes and it cracked in 1859 when it was first bonged with a hammer that was way too heavy. The crack was never repaired. Instead the bell was rotated one eighth of a turn and a lighter (200kg) hammer was installed. The cracked bell has a characteristic sound which we have all grown to love, so maybe best leave it alone.

0:58

Instead, it is the Elizabeth Tower (1859) and the clock mechanism (1854), designed by Denison and Airy, that need attention.

> *The clock mechanism itself is remarkable. In its 162-year history it has only had one major breakdown.*
>
> — Hugh Hunt



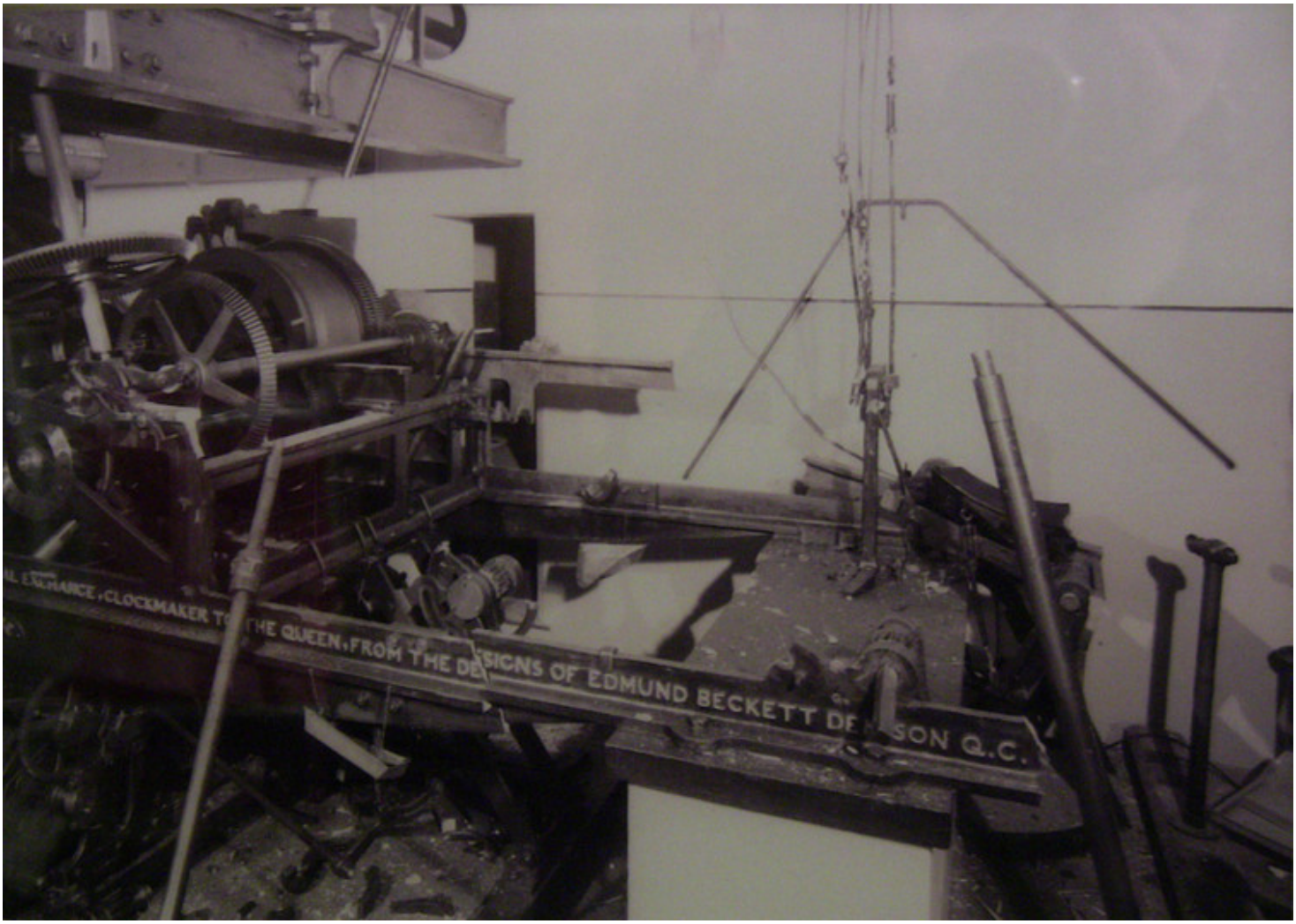
Big Ben in 1858. The Illustrated News of the World December 4 1858

Any building or machine needs regular maintenance – we paint our doors and windows when they need it and we repair or replace our cars quite routinely. It is convenient to choose a day when we're out of the house to paint the doors, or when we don't need the car to repair the brakes. But a clock just doesn't stop – especially not a clock as iconic as the Great Clock at the Palace of Westminster.

Repairs to the tower are long overdue. There is corrosion damage to the cast iron roof and to the belfry structure which keeps the bells in place. There is water damage to the masonry and condensation problems will be addressed, too. There are plumbing and electrical works to be done for a lift to be installed in one of the ventilation shafts, toilet facilities and the fitting of low-energy lighting.

Marvel of engineering

The clock mechanism itself is remarkable. In its 162-year history it has only had one major breakdown. In 1976 the speed regulator for the chimes broke and the mechanism sped up to destruction. The resulting damage took months to repair.



Big Ben's clock has had only one major breakdown, in 1976. UK Parliament, CC BY

The weights that drive the clock are, like the bells and hammers, unimaginably huge. The "drive train" that keeps the pendulum swinging and that turns the hands is driven by a weight of about 100kg. Two other weights that ring the bells are each over a tonne. If any of these weights falls out of control (as in the 1976 incident), they could do a lot of damage.

The pendulum suspension spring is especially critical because it holds up the huge pendulum bob which weighs 321kg. The swinging pendulum releases the "escapement" every two seconds which then turns the hands on the clock's four faces. If you look very closely, you will see that the minute hand doesn't move smoothly but it sits still most of the time, only moving on each tick by 1.5cm.

Pendulum suspension from a Smith of Derby clock. Hugh Hunt, Author provided

The pendulum swings back and forth 21,600 times a day. That's nearly 8m times a year, bending the pendulum spring. Like any metal, it has the potential to suffer from fatigue. The pendulum needs to be lifted out of the clock so that the spring can be closely inspected.

The clock derives its remarkable accuracy in part from the temperature compensation which is built into the construction of the pendulum. This was yet another of John Harrison's genius ideas (you probably know him from longitude fame). He came up with the solution of using metals of differing temperature expansion coefficient so that the pendulum doesn't change in length as the temperature changes with the seasons.

In the Westminster clock, the pendulum shaft is made of concentric tubes of steel and zinc. A similar construction is described for the clock in Trinity College Cambridge and near perfect temperature compensation can be achieved. But zinc is a ductile metal and the tube deforms with time under the heavy load of the 321kg pendulum bob. This "creeping" will cause the temperature compensation to jam up and become less effective.

So stopping the clock will also be a good opportunity to dismantle the pendulum completely and to check that the zinc tube is sliding freely. This in itself is a few days' work.

What makes it tick

But the truly clever bit of this clock is the escapement. All clocks have one - it's what makes the clock tick, quite literally. Denison developed his new gravity escapement especially for the Westminster clock. It decouples the driving force of the falling weight from the periodic force that maintains the motion of the pendulum. To this day, the best tower clocks in England use the gravity escapement leading to remarkable accuracy – better even than that of your quartz crystal wrist watch.

In Denison's gravity escapement, the "tick" is the impact of the "legs" of the escapement colliding with hardened steel seats. Each collision causes microscopic damage which, accumulated over millions of collisions per year, causes wear and tear affecting the accuracy of the clock. It is impossible to inspect the escapement without stopping the clock. Part of the maintenance proposed during this stoppage is a thorough overhaul of the escapement and the other workings of the clock.

One of London’s most familiar sights. EPA

The Westminster clock is a remarkable icon for London and for England. For more than 150 years it has reminded us of each hour, tirelessly. That’s what I love about clocks – they seem to carry on without a fuss. But every now and then even the most famous of clocks need a bit of tender loving care. After this period of pampering, “Big Ben” ought to be set for another 100 or so years of trouble-free running.

Hugh Hunt, Reader in Engineering Dynamics and Vibration, University of Cambridge

This article was originally published on The Conversation. Read the original article.

Published

29 Apr 2016

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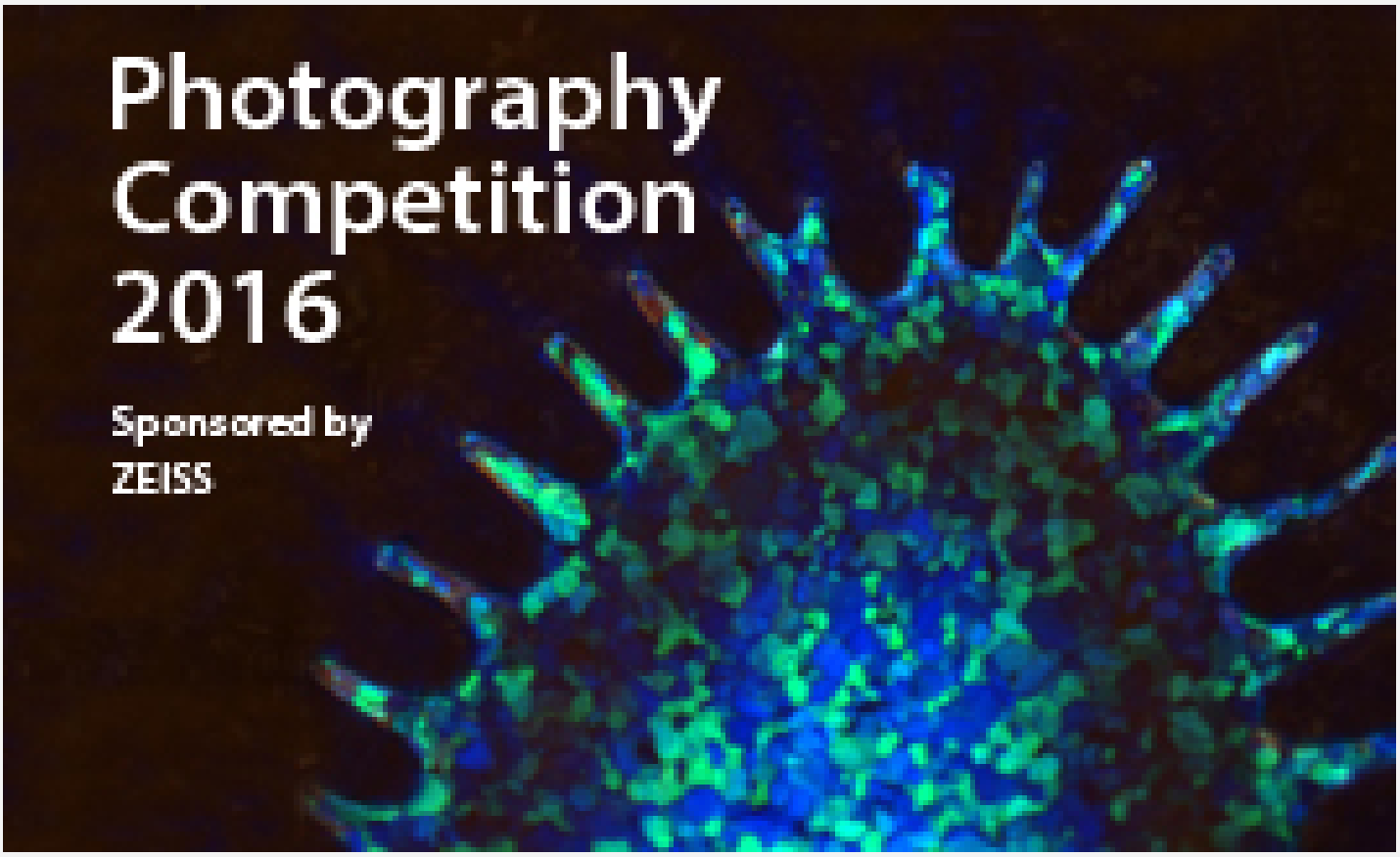

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